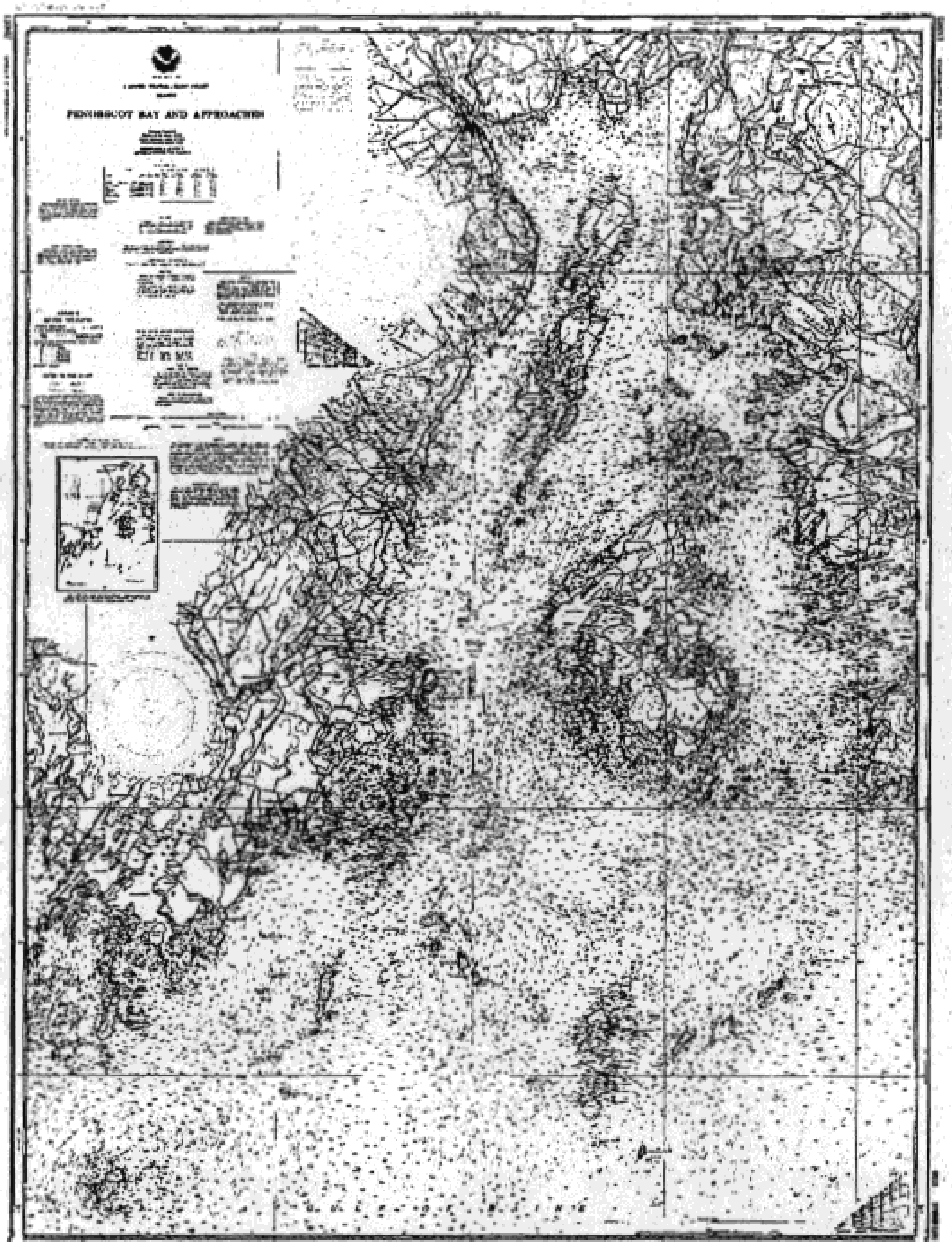
Survey of larval and juvenile Atlantic cod, *Gadus morhua*, in Penobscot Bay to provide technical assistance for cod restoration



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Survey of larval and juvenile Atlantic cod, Gadus morhua, in Penobscot Bay to provide technical assistance for cod restoration.

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Introduction

Initial steps to restore Atlantic cod, Gadus morhua, spawning populations along the Maine coast have been completed including the development of technology to raise cod from the egg stage in hatcheries and the delineation of historical cod spawning areas. The next step in the restocking experiment is to identify suitable habitat for larval and juvenile cod and to discharge hatchery reared and marked fish into waters that provide the highest potential for survival of the released fish. Factors important to the survival of larval and juvenile cod include bathymetry, surficial geology of the sea bottom, circulation within embayments, and the spatial and seasonal pattern of temperature and nutrients. It is important to groundtruth these observations by determining the present distribution and abundance of larval and juvenile cod within Penobscot Bay. To that end, we conducted field sampling to collect larval and juvenile cod and hydrographic data at selected locations based on the recently generated maps of historical cod spawning areas in Penobscot Bay. Part 1 of this report deals with the larval survey and Part 2 with the juvenile survey.

Part 1. Larval Survey

Methods

For the larval survey our efforts were concentrated in the vicinity of the historic spawning grounds within Penobscot Bay recently compiled by Ames (1996). These include: areas northeast of North Haven, between Isleboro and Northport, south of Sears Island and Cape Jellison, off of Castine, southeast of Cape Rozier and east of North Haven. Sixteen ichthyoplankton stations (Fig. 1, Table 1) were selected to encompass the bay. Six stations (A1 - A6) were located in the western portion of the bay between Isleboro and the mainland extending from off Rockland to adjacent to Marshall Point. Six stations (B1 - B6) were located in the central portion of the bay from off of Mark Island to Sears Island. Four stations (C1 - C4) were located around North Haven and Vinalhaven.

Seven two or three-day larval fish surveys (PBI - PBVII) were conducted biweekly from April through June 1997 to coincide with known spawning times for Atlantic cod. Data collection involved towing a 1.0 m plankton net with 333 micron mesh and collecting CTD (conductivity, temperature and depth) data at the16 stations during daylight hours (Fig. 1). At each station, a CTD cast was made followed immediately by a plankton tow. The meter net was fit with a flow meter and hauled for 20 minutes in stepped oblique fashion at a speed of two knots, at the surface, at 10 m and at 20 m or to within five meters of the bottom. Larvae were preserved in buffered formalin for later identification by the Atlantic Reference Center of the Huntsman Marine Biological Laboratory in St. Andrews, New Brunswick and for quantitative determination of larval fish densities (number of larvae per 100 m^3 filtered).

Results

A total of 102 1.0 m plankton net samples and CTD (conductivity, temperature, depth) measurements were collected during biweekly sampling between April 4 and June 25, 1997 in Penobscot Bay (Table 1). All sixteen stations were sampled on five of the seven sampling trips, however, inclement weather (wind speeds > 25 knots) during the first week of April (4 - 7, PBI) and in late April - early May (April 29 - May 1, PBIII) limited the number of stations that could be sampled during these trips to 10 and 12, respectively (Table 1). The CTD meter was deployed at each station, however, probe malfunction limited a complete data series to three sampling trips (PBIII, PBIV and PBVI). On the other five sampling trips, eight of 12 CTD measurements were collected during PBI, 15 of 16 during PBII and PBVII, and 10 of 16 during PBV(Table 2). CTD data are presented in Data Appendices, Tables 3 - 9 and on disk as csv files.

The number of cubic meters of water strained per 20 minute tow varied from 137.5 - 755.7 m^3 depending on station location (Fig. 2, Table 3) and sample date (Fig. 3). Likewise, the distance towed varied with sample date and station location and ranged from 222 - 962.7 m.

Results from sorting and identification of the plankton net samples (n = 102) yielded 23 species of fishes (Tables 4, 5). A total of 779 larvae were collected over the seven sampling trips. The most abundant larvae collected were radiated shanny (Ulvaria subbifurcata), sand launce (Ammodytes sp.), winter flounder (Pleuronectes americanus) and seasnail (Liparis atlanticus). Abundance and location data are presented in tabular form in Data Appendices, Tables 1 - 2, and on disk as csv files. Densities of all larvae combined ranged from 2.01 larvae per 100 m^3 in mid May (PBIV) to 11.80 larvae per 100 m^3 in late June (PBVII, Fig. 4). The high larval densities in late June were a result of the large densities of radiated shanny (Ulvaria subbifurcata) collected at the lower Bay stations.

Densities of individual larval species were of interest. The sand lance (Ammodytes sp.) densities ranged from 0 to 4.18 per 100 m^3 and were most abundant at the upper bay stations (A4 - A6, B3 - B6) and from early April (PBI) until late May (PBV, Fig. 5). They were absent from the larval collections PBV - PBVII. Winter flounder (Pleuronectes americanus), an important commercial species, were collected in densities up to 1.72 larvae per 100 m^3 and occurred in larval collections from late April (PBII) through late June (PBVII, Fig. 6). Most winter flounder larvae were collected at mid Bay stations (B1, B3, B5, B6, C2). The radiated shanny (Ulvaria subbifurcata) were the most abundant larvae in Penobscot Bay and densities ranged up to 9.07 larvae per 100 m^3 (Fig. 7). Most of these larvae were collected during June (PBVI and PBVII) and at lower bay stations B1, C1 and C4. Cod (Gadus morhua) larvae were very rare during the larval survey since only a single individual (total density = 0.03 larvae per 100 m3) was collected during the survey (Fig. 8). It was collected early on an ebbing tide at the most seaward station, C1 (lat 44.05.91, long 68.59.56), located between Owls Head and Vinalhaven on April 16, 1997 (PBII). It was 5mm NL and about 6 - 12 days old. The fact that this larvae was collected at the most seaward station in our survey suggests that it did not originate within Penobscot Bay. Table 6 compares our larval survey species list with four other inshore locations along the Maine coast including the upper Sheepscot estuary (Shaw 1981), the mouth of the Sheepscot estuary (Chenoweth et al. 1986) and Damariscotta River and Sullivan Harbor (Townsend 1984).

An extended spawning season was observed for many of the common larvae collected in Penobscot Bay (Table 7, Fig. 9). Four species, winter flounder (Pleuronectes americanus), rock gunnel (Pholis gunnellus), sea raven (Hemitripterus americanus) and seasnail (Liparis atlanticus) were collected on six of the seven sampling trips and one species (sand launce, Ammodytes sp.), occurred on five dates. Winter flounder were present from mid April (PBII) - late June (PBVII), sand launce occurred from early April (PBI) to late May (PBV), peaking in abundance in mid April (PBII), and radiated shanny (Ulvaria subbifurcata) occurred from mid May (PBIV) - late June (PBVII). Eight species were only collected during a single sampling trip including four of the six species of fish larvae originating from pelagic eggs (Table 7). However, one species with pelagic eggs, American plaice (Hippoglosoides plattesoides) occurred during all seven sampling periods. The total length of most species was remarkably constant over the survey (Table 7). For example, collected winter flounder larvae were 2 - 4 mm during mid April (PBII) and 2 - 6 mm during late June (PBVII) indicating successive spawning events. This may be due to most larvae from demersal eggs settling out of the water column and pelagic-egg larvae being displaced out of the bay during the two weeks between sampling trips. Plankton volume ranged from three to 210 cc per liter and generally was greater from early - mid April (PBI and PBII, Fig. 10) with a secondary peak in abundance observed in late June (PBVII). Greatest plankton volumes occurred at the lower bay stations B1, C1, C3 and C4 (Fig. 11).

Larvae from demersal eggs dominated the catches for the majority of the survey (Fig. 12), but there was an increase in the number of larvae originating from pelagic eggs in June. Only one or two larvae from pelagic eggs were collected from early April (PBI) through early June (PBVI). However, five of eight species of larvae collected in late June (PBVII) originated from pelagic eggs. Overall, most species of larvae collected in Penobscot Bay hatched from demersal eggs (70%) compared with pelagic eggs (26%). The number of larvae from demersal eggs dominated the catch at all stations (Fig. 13).

Discussion

The results of our Penobscot Bay larval survey compare well with other nearshore ichthyplankton surveys of the Maine coast including the upper Sheepscot estuary (Shaw 1981), the mouth of the Sheepscot estuary (Chenoweth et al. 1986) and Damariscotta River and Sullivan Harbor (Townsend 1984). Cod larvae were uncommon (1 larvae/284000 m^3), a not wholly unexpected result since cod larvae were rare (Shaw 1981) or absent from other recent ichthyplankton surveys (Chenoweth et al. 1986, Townsend 1984) of nearshore Maine waters (Table 6). Shaw (1981) reported only 26 cod larvae taken during almost nine years of ichthyoplankton work in the upper Sheepscot estuary while no cod larvae occurred at the other three locations sampled in the latter two studies. Although historically an inshore spawning population of cod were known to utilize Sheepscot Bay in May and June (Perkins 1982), their eggs did not remain long in Sheepscot Bay and very few larvae were taken in 1984 and 1985 (Chenoweth and Perkins 1989). There was a downward trend in cod egg production in Sheepscot Bay from 1983 (200 eggs/100 m^3) to less than 40/100 m^3 in 1985 and larval production also declined from 5 larvae/100 m^3 in 1983 to less than 1/100 m^3 in 1985. The life history strategies employed by species of fish during the development of their eggs and larvae are varied and of critical importance to their survival. Cod may have been rare in Penobscot Bay due to their reproductive ecology, particularly the fact that their eggs and larvae are pelagic and this will be discussed below. Although cod were the focus of this survey, good information was obtained on the abundance and distribution of other late winter to early summer spawned species of fish within the bay. Penobscot Bay lies between a coastal shelf to the east on which strong tidal mixing prevails while to the west the coastal shelf exhibits more fresh water run-off and vertical stratification with a seasonal southwesterly net current flow along the coast connecting the two hydrographic regimes. Penobscot Bay, therefore, provides a connection to open ocean and estuarine habitats for the development of fish eggs and larvae, and thereby an opportunity for fish species to diversify their survival strategies during early development.

A general discussion of the larval fish ecology based on Chenoweth (1988) follows. Within the Gulf of Maine, Bigelow (1926) recognized the significance of the coastal shelf for the production of fish larvae noting that most larvae caught in his plankton tows came from the coastal belt out to about the 200 meter contour. He also observed that their drift was generally to the southwest and that their abundance increased progressively to the west with few larvae observed in eastern Maine and the Bay of Fundy. His studies were followed by other surveys which defined the composition of the larval fish fauna of the Gulf of Maine (Fish and Johnson 1937, Marak 1960, Marak and Colton 1961, 1962). In addition, there have been numerous ichthyoplankton studies in certain nearshore Maine locations, ie. the Sheepscot and Damariscotta estuaries, which were for the most part confined to sampling areas well within the headlands (Chenoweth 1973, Graham 1972, Hauser 1973, Shaw 1981, Laroche 1982, and Townsend 1981, 1983, 1984). There has also been an unpublished study (Chenoweth et al. 1986) in Sheepscot Bay of what might be called a "transition zone" between the estuaries and open Gulf waters. This zone is located at the mouths of estuaries and embayments out to the coastal islands. Little historical ichthyoplankton information exists for Penobscot Bay.

The ichthyoplankton community of Penobscot Bay is similar to other coastal estuaries in the Gulf of Maine and the northwest Atlantic Ocean. Pearcy and Richards (1962) first noted that, with a few exceptions, the Mystic River Estuary was inhabited by two types of larval fish. Larvae that hatched from demersal eggs dominated the catch within the estuary, while larvae that hatched from pelagic eggs were more common at the mouth of the estuary. The time of peak abundance also differed. The abundance of larvae from demersal eggs peaked in the winter-spring period while that of larvae from pelagic eggs typically peaked in the summer. Likewise, Able (1978) observed that the St. Lawrence estuary was almost exclusively inhabited by larvae that hatched from demersal eggs, primarily cottids, stichaeids, winter flounder, and herring and that the larvae from pelagic eggs were merely strays within the estuary.

Domination of the ichthyofauna by larvae from demersal eggs holds for Penobscot bay and other Maine embayments and estuaries as well. The species composition from our Penobscot Bay survey and those of the upper Sheepscot (Shaw 1981), the mouth of the Sheepscot (Chenoweth et al. 1986), and the Damariscotta River estuary (Townsend, 1981, 1984) and Sullivan Harbor (Townsend, 1984) shows that larvae from demersal eggs dominated the larval fish fauna within these areas. Sixteen of 23 species (70%) of larvae collected in this study were from demersal eggs. Twenty-six species of larvae were taken in the mouth of the Sheepscot with a comparatively large number of pelagic egg species (41%) relative to demersal egg species, as might be expected in an area strongly influenced by coastal water. In upper Sheepscot Bay, 42 species of fish larvae were taken, but this relatively high number reflects the long time series (nine years) of this survey and the inclusion of several coastal species that were rare in the total catch. Even so, these catches were dominated by demersal egg laying species (76%). In the Damariscotta estuary and Sullivan Harbor, there were 22 kinds of fish larvae caught, but only one species (<1%) was from pelagic eggs (Townsend, 1981, 1984). Lee (1975) did not take any pelagic egg species in his samples of the Damariscotta estuary. It is possible that the greater dominance of demersal egg species in the Damariscotta is due to the constriction of the headlands near the mouth-of the estuary that limits the influence of coastal water, although Townsend's sampling also did not extend far into the summer when the pelagic-egg larvae become more abundant.

Egg type has major implications on larval fish ecology. Chenoweth (1988) stated the most obvious difference in reproductive strategies of fish along the central Maine coast was whether they produce pelagic or demersal eggs. There are major differences in size at first hatch, and egg diameter between the species in Gulf of Maine that lay pelagic eggs and those that lay demersal eggs. The larvae from pelagic eggs typically hatch at a relatively small size from relatively small eggs and during the warmer months of the year. On the other hand, the larvae from demersal eggs generally hatch at relatively larger size from large eggs and in the colder months of the year. The characteristics of ichthyoplankton in Penobscot Bay, then, follow very closely those reported for the Mystic Estuary by Pearcy and Richards (1962) and for the St. Lawrence estuary by Able (1978). Coastal shelf spawners such as cod, fourbeard rockling(E. cimbrius), American plaice (H. plattesoides), and cunner (T. adspersus) lay pelagic eggs that may be dispersed over a wide area according to the counterclockwise current flow in the Gulf of Maine (Sherman et al. 1984). Nearshore spawners such as winter flounder (P. americanus), rock gunnel (P. gunnellus), cottids (Myoxocephalus sp.), stichaeids (U. subbifurcata), and herring (C. harengus) lay demersal eggs, and depend on protected areas of the coastline for nursery areas. The advantage of demersal eggs to species that depend on nearshore areas is that transport during the completely passive egg stage is eliminated and the larvae hatch into the landward moving bottom layer (Pearcy and Richards 1962, Norcross and Shaw 1984)

Pelagic eggs are generally small and the larvae are poorly developed when they hatch (Houde 1978). They depend exclusively on yolk reserves for a week or two before they begin active feeding, so initial feeding success is critical to survival. Cod, and many other species are pelagic egg layers whose larvae hatch at a relatively small size and require a short period after hatching to fully develop and begin active feeding. These larvae seem to require relatively high food concentrations during the first few days of life and that the highest concentrations of food occur during the warmer months. Fish that produce pelagic eggs therefore produce many eggs and locate them in areas and at times when the concentration of food is potentially the highest (Chenoweth 1988). As a rule, demersal eggs are relatively large and the larvae that hatch from them are large and robust with well developed eyes, mouths and guts. When they hatch they are mobile and ready to begin feeding. It does not appear that the larvae from demersal egg layers demand high food concentrations for survival. They seem to be better able to capture prey and able to ingest a wider variety of prey than larvae that hatch from pelagic eggs. Most of these food items (ie. barnacle and fish larvae) were much larger but less abundant than the copepod nauplii used by larvae from pelagic eggs and found later in the year. It appears that the winter-spring larvae that hatch from demersal eggs are opportunistic and take advantage of what is available to them at the time, which are larger, but less abundant food organisms than those available to larvae that hatch from pelagic eggs during the warmer months (Chenoweth 1988).

The spawning times of marine species in temperate waters appear to be timed to take advantage of the seasonal production cycle of plankton (Cushing 1970, Baganel 1971, Quasim 1956). There is ample evidence of this along the Maine coast where phytoplankton production begins between January and April in the southwestern Gulf of Maine and proceeds eastward along the coast, followed by the production of zooplankton (Bigelow 1926). Fish and Johnson (1937) noted that larval fish populations adapted their spawning times to this production cycle and thus spawned later in the east than the west. Species of fish that lay pelagic eggs appear to use this particular strategy to optimize the food levels available to their larvae at hatching and during the early stages of their development. Chenoweth (1988) discussed an interesting example of delayed spawning in the the cod stocks in the western Gulf of Maine that illustrates this theory. There is a well documented spawning cycle (Bigelow and Schroeder 1953, Fish 1928) for cod which begins in January - February in Massachusetts Bay, in March and April around Cape Ann but as late as June for a group of cod that spawned year after year in Sheepscot Bay (Perkins 1982). The peak egg production of cod in the Sheepscot in June is followed in July by the maximum abundance of cod larvae, which again seem to be generally timed to the maximum production of copepod nauplii. However, in producing larvae during the summer the Sheepscot cod may be pushing their temperature tolerances since cod generally prefer cold water and move away from the coast during the warm summer months into deeper water and their eggs also have a low tolerance for warm water. By June, when cod spawning in the Sheepscot peaks, the surface temperatures in Sheepscot Bay are at or above 12°C, temperatures lethal to their eggs, and well above it to the west, where cod eggs and larvae from the central Maine coast are supposed to drift (Schroeder 1930). But any larvae thus produced would have the advantage of a relatively abundant food supply for their early development although there is considerable year to year variability in precisely when plankton production occurs (Townsend 1981, 1984). Some demersal egg laying species also may utilize a protracted spawning strategy to take advantage of brief and variable bursts of a particularly nutritious food supply. Townsend (1981) has shown that the rock gunnel, Pholis gunnellus, larvae were present in the Damariscotta estuary for three or four months and suggested that by extending the hatching period this species would be able to maximize the likelihood of co-occurring with abundant food. This may be a common feature of other demersal egg laying species whose larvae are present in the winter-spring period when food may be relatively sparse.

Species of fish larvae behave differently in the water column (Fortier and Leggett, 1982, 1983, Graham, 1972, Shaw, 1981, Able, 1978, Norcross and Shaw, 1984). The contrast in larval mobility between pelagic and demersal egg laying species is obvious. Strong swimming by larval fish does not start until active feeding begins (Fortier and Leggett, 1982), therefore the delayed initiation of feeding by larvae from pelagic eggs means these larvae will drift passively in the water for a week or two. Cod, on the other hand, appeared to drift passively near the surface and tended to be flushed out of the St. Lawrence estuary (Able 1978). Therefore, it seems likely that any cod larvae that originate within the Penobscot Bay would be flushed out of the system since surface net current flows would move them into nearshore waters. On the other hand, precocious larvae from demersal eggs will become mobile almost immediately after hatching, which allows them to adjust their position in the water column and maintain themselves in the nearshore environment. Chenoweth (1988) discussed the contrast in larval distribution between cod and herring in the Sheepscot that illustrates different behavioral adaptations to planktonic transport. Both species spawn along the Maine coast, cod right in Sheepscot Bay and herring at various locations to the east of Penobscot Bay. The pelagic cod eggs are taken in abundance in the Sheepscot but the larvae are rarely taken within the headlands. Herring, on the other hand, hatch from demersal eggs at some distance from the Sheepscot, yet they are one of the most abundant species of larval fish in the upper Sheepscot estuary. Behavioral strategies of these fish larvae could well prove to be the most important survival mechanism employed during early development.

We will focus our ichthyoplankton survey in the spring of 1998 from mid March - early May on the seaward portion of the Bay (stations A1 - 2, B1 - 2, and C1 - 4) and with the addition of one station offshore of both stations C1 and C4 in an effort to collect more cod larvae.

Part 2. Juvenile Survey
Methods

Our Penobscot Bay juvenile survey was based on juvenile cod, Gadus morhua, utilizing shallow inshore habitats for resting or feeding as seen in many areas of the North Atlantic including Sweden (Pihl 1982), Russia (Girsa and Zhuravel 1983), the lower Bay of Fundy (Macdonald et al. 1984), Newfoundland (Clark and Green 1990, Keats 1990, Keats and Steele 1992) and Scotland (Gibson et al. 1993, 1996). Extensive sampling for juvenile fishes in shallow subtidal habitats throughout Penobscot Bay began in August 1997 and continued into September. Regular sampling was conducted with a beam trawl in a variety of habitats characteristic of the Penobscot Bay system. Sample station locations are shown in Fig. 14 and described in Table 8. A 1.0 m beam trawl was used to make qualitative or representative collections of decapod crustaceans and fishes. Fourteen shallow subtidal (< 20m) stations with towable bottom were selected and sampled during daylight hours over the period from August 25 to 27. In September, three stations were sampled after dusk each night on September 2 and 3, and on September 9 and 10. At each location, three replicate two - five minutes tows were made with a small beam trawl (0.3 cm codend mesh) to increase the likelihood of capturing rare species. Replicate samples were kept separate, sorted live, and discarded except for species of particular interest, which were preserved in 10% formalin. All decapod crustaceans and fish were identified, counted and measured.

Results

Our comprehensive sampling with a beam trawl (78 tows) during August and September 1997 captured over 8129 organisms, including 202 fishes and 7927 decapods. Fish and decapod species richness and catch per tow (natural log of abundance), compared by habitat, are included in Figs. 15 and 16, respectively. The sand shrimp, Crangon septemspinosa was the most abundant species followed by the green crab, Carcinus maenas, and Pandalid shrimp (Tables 9, 10). The grubby (Myoxocephalus aenaeus) winter flounder (Pleuronectes americanus) and three spined stickleback (Gasterosteus aculeatus) were the most abundant fishes. No juvenile cod were collected in day or night tows and only one gadoid species, a white hake (Urophycis tenuis) was collected.

Over the limited sampling period (August and September), 16 species of fishes and five species of decapod crustaceans were collected. Both the decapod and fish faunas were dominated by a relatively few species, but the temporal and spatial patterns of abundance varied considerably. In the beam trawl collections, four fishes, the grubby (Myoxocephalus aenaeus), lumpfish (Cyclopterus lumpus), winter flounder (Pleuronectes americanus), and the three-spined stickleback (Gasterosteus aculeatus), made up 72.3% of the total fishes collected. Decapod crustaceans in trawl collections were dominated by sand shrimp (Crangon septemspinosa) and green crab (Carcinus maenas) which together made up 95.5 and 2.3%, respectively (Table 10).

The patterns of fish and decapod species occurrence and abundance as reflected in trawl collections, varied between habitats (Table 11). The number of fish species ranked highest over sand, followed by collections in eelgrass and gravel (Fig. 15). In contrast, the eelgrass areas harbored greater number of decapod species followed by cobble. However, effort was also greatest over sand (33 tows) compared with gravel and cobble (12 tows each). Fish were most abundant (catch per tow) in eelgrass, followed by collections over sand (Fig. 16). Fish were much less abundant over cobble substrates. Similarly, the sand substrate harbored an order of magnitude greater abundance of decapod crustaceans, with cobble, gravel, and eelgrass all ranking much lower.

The habitat specific patterns for fish species can be discerned by examining the collections from each station/habitat (Table 11). The high number of species (6) observed in the sand habitats are the result of the collection of rarer species, ie. cunner (Tautogolabrus adspersus), Atlantic silverside (Menidia menidia), and ninespined stickleback (Pungitius pungitius) through increased effort at the Saturday Cove and Marshall Point stations. Five species occurred in the eelgrass habitats including the less common Gulf seasnail (Liparis coheni) and rock gunnel (Pholis gunnellus) at the Owls Head Station. Five species, including the single white hake (Urophycis tenuis) collected, also occurred at Gull Point Station. The higher relative abundance observed in the sand habitats was the result of the collection of larger numbers of threespined sticklebacks (Gasterosteus aculeatus), herring (Clupea harengus), and winter flounder (Pleuronectes americanus) at the Saturday Cove and Marshall Point Stations. Most of the fishes observed in the eelgrass habitats were grubbies (Myoxocephalus aenaeus) collected at Owls Head Station.

For decapods, which were dominated numerically by two species, sand shrimp (Crangon septemspinosa) and green crab (Carcinus maenas), the sand habitat had the greatest abundance (Table 11, Fig. 16). Sand shrimp occurred in all habitats but were most abundant over sand bottoms at Marshall Point where they averaged 527 individuals/tow. The next most abundant collections of sand shrimp (330 individuals/tow) were over sand at a nearby station (Saturday Cove). Green crabs were most abundant in the eelgrass habitat at Owls Head Station, where they averaged 16 individuals/tow.

In an attempt to discern diurnal patterns of utilization in habitats, we made 36 night trawls at eight stations during September of 1997 (Table 12). In the diurnal comparisons, more fish species were collected at night than during the day (Fig. 17). Fish were also more abundant in night tows with the exception of uncommon species such as fourspined stickleback (Gasterosteus aculeatus), plaice (Hippoglossoides plattesoides) and Gulf seasnail (Liparis coheni, Fig. 18). All decapods including sand shrimp (Crangon septemspinosus), rock crab (Cancer sp.), and green crab (Carcinus maenas) were more abundant at night (Fig. 18).

In general, the fish and decapod fauna can be characterized as consisting of a large number of resident species and few migratory species (catadromous and transients, Table 13). Many species use Penobscot Bay as a nursery area, indicated by the preponderance of juvenile stages. Several of these are of commercial or recreational importance including Atlantic herring (Clupea harengus), white hake (Urophycis tenuis), and winter flounder (Pleuronectes americanus). Others are important prey for some of the above species including Atlantic silverside (Menidia menidia), sand launce (Ammodytes sp.), and sand shrimp (Crangon septemspinosus). Further, these juveniles are undoubtedly prey for the system's shorebird populations. The habitats utilized by these forms may be classified by thc degree of fidelity to a specific habitat. Some of the pelagic forms, such as Atlantic herring and inshore sand launce, occur over a variety of substrates (i.e., habitat generalists) and this may occur in some benthic forms as well (i.e., winter flounder). Others appear more restricted in the habitats they utilize, for example grubby appear to require three-dimensional structures such as eelgrass.

Life History of Select Species

The following treatments address aspects of the life history for select species that occurred in the collections used to characterize the fauna of Penobscot Bay. Treatment follows in a phylogenetic order.

Atlantic Herring (Clupea harengus)

Small juvenile Atlantic herring appear to utilize Penobscot Bay as a nursery area during the summer (Fig. 19). A single mode, representing recently metamorphosed individuals, first appeared in collections in September. These were the result of last autumn's spawning along outer bay or off of downeast Maine since late-stage larvae were collected within Penobscot Bay in April and May.

White Hake (Urophycis tenuis)

We collected a single individual (135 mm TL) during a September 8th night tow at Gull Point. White hake was of interest because, although it is commercially important, little is known of the juvenile habitat. Fahay and Able (1989) discovered white hake to be common components within Cape Cod estuaries where they move into eelgrass and peat reef habitats during late spring-early summer at sizes of 50 - 100 mm total length. They are resident and continue to grow at least through October, when they reach 200 - 300 mm before disappearing in early winter.

Threespined Stickleback (Gasterosteus aculeatus)

This species uses Penobscot Bay as a nursery area (Fig. 19). Although they were collected on each sampling trip, most individuals are thought to move into deeper waters or offshore during the winter. These adults are represented by larger individuals (approximately 37 - 51 mm TL) collected.

Sand Launce (Ammodytes sp.)

This is one of the more common species in Penobscot Bay but was not well represented in our collections (Fig. 19). Spawning occurs in early spring and recently hatched larvae were collected in April. Individuals of a similar size range (80 - 115 mm TL) were collected during the three collecting periods.

Grubby (Myoxocephalus aenaeus)

The grubby is a year-round resident of Penobscot Bay where it occurs primarily in eelgrass habitats (Fig. 19). Larvae hatch in mid winter and occur in plankton collections throughout the estuary in April and early May. Juveniles first appear in summer collections. Grubbies of all sizes feed primarily on crustaceans, particularly sand shrimp.

Winter Flounder (Pleuronectes americanus)

This commercially important species appears to be a year round resident of Penobscot Bay (Fig. 19). Spawning occurs in late winter to early spring since recently hatched larvae were collected from April - June. This same year class is probably represented by 27 - 55 mm individuals in August and 30 - 105 mm individuals in September. One year old fish may be represented by the 95 - 175 mm individuals collected in September. Another individual (330 mm, presumably an adult) also was collected in September.

Sand Shrimp (Crangon septemspinosa)

The sand shrimp is a resident of Penobscot Bay and was very abundant especially in our September collections. Spawning had already occurred by September since large numbers of small individuals (15 - 19 mm) were collected.

Green Crab (Carcinus maenas)

This species was a resident species based on its frequent collection. Recruitment of small individuals (5 - 9 mm carapace width) apparently occurred during the fall based on their occurrence in September.

Discussion

We did not collect any juvenile cod in our survey of shallow subtidal habitats in Penobscot Bay, but we did obtain good information on the late-summer occurrence and distribution of other fishes and decapods. We will discuss the reults of the juvenile survey first followed by some general habitat information for juvenile cod. Valid comparisons depend on the use of equivalent sampling gears and stategies at comparable latitudes for similar lengths of time (Ross 1983) and species richness and abundance estimates are frequently biassed by the use of selective gear types (Gibson 1973, Riley et al. 1981), so we can make only general comparisons between the fish fauna of Penobscot Bay and other studies of Maine shallow marine habitats. The fish fauna (16 species) collected in Penobscot Bay was similar to that of Montsweag Bay (Targett and McCleave 1974), Wells Harbor (Ayvazian et al. 1992) and Sagadahoc Bay (Lazzari et al. In review), smaller estuarine systems located south of Penobscot Bay (Table 14). These studies all sampled for a longer time period (> one year) and in other areas beside the shallow subtidal waters that were sampled in Penobscot Bay and reported a number of common species, including alewife (Alosa pseudoharengus), smelt (Osmersus mordax), pollock (Pollachius virens), tomcod (Microgadus tomcod), killifish (Fundulus heteroclitus), and bluefish (Pomatomus saltatrix), that did not appear in our Penobscot Bay samples, Juvenile cod were absent from our Penobscot Bay samples and also were not caught in the former two studies. They were only rarely collected in the five-year Sagadahoc Bay study where they comprised less than 0.1% of the fishes collected. Only a single gadoid fish, white hake, U. tenuis, was collected in our juvenile survey. The decapod fauna (five species) closely resembled that of other New England estuaries (i.e. Nauset Marsh, Heck et al. (1989) and Pleasant Bay, Fiske et al. (1967) on Cape Cod). Most decapod species were ubiquitous to estuarine systems of New England (Teal 1986) although these studies did not report northern shrimp (Pandalus sp.) as we did for Penobscot Bay. Lobster (Homarus americanus) was rare in our collections.

As in most other shallow water fish communities (Allen and Horn 1975), a few common species were dominant in terms of numbers, considered an adequate measures of fish community composition (Bianchi and Hoisaeter 1992). Our trawl catches consisted predominantly (72%) of three benthic species (winter flounder, P. americanus, grubby, M. aeneus, and threespined stickleback, G. aculeatus). Older individuals were rare and mainly restricted to 1-yr-old juveniles remaining from the previous year's recruitment, as in winter flounder, or adults of species that breed in the immediate environment, such as threespined stickleback. Four species, mummichog (Fundulus heteroclitus), smooth flounder (Liosetta putnami), Atlantic silversides (Menidia menidia) and the Atlantic herring (Clupea harengus) comprised 98% of the catch in Montswaeg Bay (Targett and McCleave 1974). In Wells Harbor, the ninespine stickleback (Pungitius pungitius), mummichog (Fundulus heteroclitus), sand launce (Ammodytes americanus) and Atlantic silversides (Menidia menidia) were major faunal components comprising over 90% of the total number of individuals (Ayvazian et al. 1992). Tomcod (Microgadus tomcod), mummichog, sand launce, and Atlantic silversides were the dominant species collected in Sagadahoc Bay (Lazzari et al. In review). Typically, the number of species and abundance of fishes showed a pronounced seasonal cycle in other areas in Maine (Targett and McCleave 1974, Ayvazian et al. 1992, Lazzari et al. In review) with peak numbers occurring during late summer when our juvenile survey took place.

Habitat utilization by fishes in Penobscot Bay was typical of embayments in the Acadian zoogeographic province where the resident life history category has the greatest number of species (Table 13). In the Virginian zoogeographic province to the south of Cape Cod, the marine group contains more species at most locations. This follows Tyler's (1971) model of fish community composition that suggests with decreasing latitude and increasing water temperature there will be a trend toward proportionately more seasonal or irregular species and fewer regular (resident) species in the total assemblage. The percent contribution to the number of species by life history groups in Wells Harbor showed a trend toward an increase in diadromous and resident species and an decrease in nursery and marine species when compared with the fish fauna of a Cape Cod estuary (Ayvazian et al 1992).

Many fish species, including commercially or recreationally important species such as Atlantic herring, white hake, U. tenuis, and winter flounder, used shallow habitats in Penobscot Bay as indicated by the presence of their juveniles in the collections. Shallow water habitats in Penobscot Bay may function as a fish nursery ground in common with many other parts of the indented coast of Maine (Targett and McCleave 1974, Ayvazian et al. 1992, Lazzari et al. In review) and with sandy beaches in many other parts of the world (Brown and McLachlan 1991, Hook 1991). The use of shallow water habitat as nursery area by fishes of commercial importance has received little attention in the northwest Atlantic while this fact has been amply demonstrated for many fish species in northern Europe (Edwards and Steele 1968, Zijlistra 1972, Gibson 1993, 1996). The importance of soft bottoms in marine shallow areas as nursery and feeding grounds has been demonstrated for Atlantic cod and pollock in Europe (Zijlstra 1972, Burd 1978, Daan 1978, Rauck and Zijlstra l978,) and in Canada (Keats 1986, 1990, Keats et al. 1987). Macdonald et al. (1984) found the shallow beach habitat in the Bay of Fundy region apparently served as a major nursery area for juvenile gadids and thought the use of shallow water and beach habitat by these fishes makes them susceptible to coastal pollution impacts and puts their adult fisheries at risk to coastal degradation and development. However, shallow beach habitats in Penobscot Bay also harbor the abundant crustaceans (Crangon septemspinosus and Carcinus maenas), species known to be major predators of small fishes (van der Veer & Bergman1987).

The distributions of fishes are determined by a complex series of responses to both the physical and biological characteristics of their environment (Gibson et al. 1996). Many species move from one habitat to another on a variety of spatial and temporal scales and habitats themselves vary regularly on daily and seasonal bases. Changes in the late-summer species composition of our Penobscot Bay catches over the diel cycle were relatively small and there was no evidence for the existence of distinct, exclusive 'day' and 'night' communities (Helfman 1993). Although more species were caught at night overall, the differerence was slight and the changes usually were caused by the changing abundance of particular species rather than by their presence or absence. Increased numbers of fishes moving into shallower water at night have also been recorded in several other locations (Horn 1980, Ross et al. 1987, Wright 1989, Romer 1990). Both feeding and predator avoidance have been cited as the function of such movements but the reverse argument has also been made, i.e. fishes avoid shallow water during the day because of increased predation risk from diurnal predators, particularly birds. In other studies undertaken elsewhere, diel changes have been observed in species composition, size distribution and abundance (Lasiak 1984, Nash 1986, Ross et al. 1987) and related to day/night differences in net avoidance and to diel onshore-offshore movements. This was shown by the nocturnal absence of the diurnal sandeel species and the onshore movement of gadoids at sunset in Scotland (Gibson 1993). Another species that clearly shows this pattern was winter flounder, Pleuronectes americanus (Pearcy 1962).

In the lower Bay of Fundy region, Macdonald et al. (1984) found there was a seasonal progressive seaward displacement of five fish assemblages, dominated by pleuronectids, cottids, gadids, clupeids, and rajids, from shallow, inshore to deeper, offshore habitats in winter followed by a reversal during summer. For many species such as herring (C. harengus), seasonal movement from inshore habitat to offshore is unidirectional for the individual, since the beach community consists of a new 0+ yearclass each year. For other species (winter flounder, P. americanus, juvenile sculpins, Myoxocephalus sp., and radiated shanny, E. cimbrius), the return inshore was an annual occurrence, triggered perhaps as much by resource availability and predator avoidance as by physiology. Seasonal movements have been commonly reported elsewhere (i.e. Creutzberg and Fonds 1971, Horn 1980, Ross et al.1987). Another factor contributing to the decline in numbers over the year is likely to be emigration into deeper water, as is known to take place in P. americanus (Pearcy 1962) or an apparent decline caused by the increasing size of many species making them less available to the sampling gear.

A brief discussion of the literature related to juvenile cod habitat follows. Cod and other gadids are known to utilize shallow beach areas in other parts of the northeastern Atlantic Ocean (Pihl 1982, Girsa and Zhuravel 1983, Gibson et al. 1993, 1996) where they were found to be more abundant in shallow water at night. This indicates an onshore migration at dusk followed by an offshore migration at dawn, a movement pattern observed for many gadoid species on a Scottish beach including cod, Gadus morhua, and haddock, Melanogrammus aeglefinus (Gibson et al. 1993, 1996). These researchers have proposed that nocturnal inshore migration may be a characteristic behavior pattern of the juveniles of shallow water members of the Gadidae. It has certainly been recorded in several different locations for cod, G. morhua including Sweden (Pihl 1982), Russia (Girsa and Zhuravel 1983), and Scotland (Gibson et al. 1993, 1996), although the patterns of movement, and the functions attributed to them, differ between areas. For example, Pihl (1982) reported that age 1+ juvenile cod in Sweden came into a shallow cove at night to feed on mobile epifauna. Other research found tagged juvenile cod remained in shallow stations (5 - 10m) where they were released during summer and autumn before beginning a general offshore movement at age 2+ (30 - 50 cm) to deeper water (Pihl and Ulmestrand 1993).

Similar findings concerning the ecology of juvenile cod exist for the northwestern Atlantic Ocean. Inshore waters of eastern Newfoundland provide nursery grounds for juvenile cod (Lear and Wells 1984) in places such as Conception Bay (Keats et al. 1987, Clark and Green 1990), and Bonavista Bay (Keats 1990, Keats and Steele 1992). Juveniles (age 0+ to 2+) were common in shallow water (< 25 m) of Conception Bay from spring through autumn (Keats 1986, Keats et al. 1987), but there was some confusion about where juvenile cod spend the day. They are thought to move near the bottom in deeper water since older cod (age 1+ and 2+) preferred seaweed beds over bottoms dominated by sea urchins and coralline algae in Conception Bay (Keats et al. 1987) and a few age 0+ individuals were found in crevices (Keats 1986). However, no association with seaweed was observed for the older ages in later research in Bonavista Bay (Keats 1990). Keats (1990) also found juvenile cod undertake inshore migrations at night since they were 16 times more abundant in shallow water of the Bonavista Bay at night than during the day. Keats and Steele (1992) observed cod were evenly distributed in all habitats sampled at night in Bonavista Bay, suggesting some flexibility in patterns of habitat use. However, in the presence of a predator, cod will change their habitat preference since juvenile cod in Newfoundland preferred sand or gravel when there was no apparent predation risk, but chose cobble when a predator was near (Gotceitas and Brown 1993). Clark and Green (1990) found age 3 cod (28 - 33 cm TL) were nocturnally active in Conception Bay, Newfoundland and migrated between deep (30 m) and shallow (< 15 m) areas where they fed, but Keats and Steele (1992) found no evidence that the nocturnal migrations in Newfoundland were related to feeding since cod there fed mainly in the day. Rather than acting as a feeding area, shallow water could be a refuge since cod are cannibalistic and larger juveniles (age 3+) feed on smaller juveniles (age 1+) and adults feed on all younger groups (Schroeder 1930). Given their cannabilistic nature, it would be adaptive for smaller individuals to segregate from the larger stages and adults and Keats et al. (1987) thought this may explain their inshore movement at night. MacDonald et al. (1984) found obvious differences in sizeclass distributions and abundance between summer and winter populations of winter flounder and Atlantic cod at offshore sites in the Bay of Fundy and a complete lack of most adult fish inshore. This also suggests marked segregation between juveniles (at least 0+ age group) and adults for these species. Information on juvenile cod in Maine inshore waters is sparse compared with these other areas. In a four year survey of groundfish in Sheepscot Bay in the late 1970's and early 1980's, Perkins (1982) found substantial concentrations of young-of-year (0+) cod within the bay and older juvenile cod remained there throughout the year. Recent surveys outside the headlands continue to collect juveniles here. Juvenile cod (< 20 cm in total length, n = 177) also were collected in Penobscot Bay as part of a northern shrimp survey between November 1980 and March 1981 (Stevenson 1983) where they were captured in waters between 14 and 90 m deep. However, a just completed trawl survey in Penobscot Bay at seven locations in deeper water (> 25 m) throughout the bay collected only a single juvenile cod (160 mm total length) in nine tows. We will sample both shallow subtidal habitats and deeper water as part of our RoxAnn substrate survey and hopefully will collect juvenile cod in 1998.

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List of Tables

Table 12. Abundance of juvenile fishes and decapod crustaceans by station and time of collection with 1.0 m beam trawl in Penobscot Bay in August and September1997. Species abbreviations as noted in Table 4.

Table 13. Utilization of Penobscot Bay by fishes and decapod crustaceans from April - September 1997. Habitat utilization as follows: Gr = gravel, Co = cobbles, Eg = eelgrass and Sa = sand.

Table 14. Comparison of fish species (n = 16) collected in Penobscot Bay with 1.0 m beam trawl from August - September 1997 with three other Maine estuarine studies.

Table 1. Stations sampled biweekly by 1.0 m plankton net in Penobscot Bay from April 4 through June 25, 1997.

Station	Location (Lat/long)	Sampling Trip 1	2	3	4	5	6	7
Western Bay								
A1(Rockland)	44.07.96/69.02.68	x	x	x	x	x	x	x
A2(Camden)	44.09.70/69.01.70	x	x	x	x	x	x	x
A3(Mt. Meg)	44.13.28/68.59.85	x	x	x	x	x	x	x
A4(Linconvil)	44.15.93/68.58.49		x	x	x	x	x	x
A5(Flat Is.)	44.18.37/68.57.25		x	x	x	x	x	x
A6(Marshall)	44.21.45/68.55.85		x	x	x	x	x	x
Eastern Bay								
B1(Saddle Is.)	44.10.20/68.57.18	x	x	x	x	x	x	x
B2(Compass I)	44.12.76/68.54.88	x	x	x		x	x	x
B3(Resolution)	44.15.38/68.53.47	x	x	x		x	x	x
B4(C. Rosier)	44.18.92/68.51.69		x		x	x	x	x
B5(Castine)	44.21.62/68.50.98		x		x	x	x	x
B6(Sears Is.)	44.24.90/68.53.64		x	x	x	x	x	x
North & Vinalhaven								
C1(Owls H)	44.05.91/68.59.56	x	x	x	x	x	x	x
C2(North H)	44.11.05/68.52.81	x	x	x	x	x	x	x
C3(Deer Is.)	44.12.27/68.45.14	x	x	x	x	x	x	x
C4(Fox I Tho)	44.09.39/68.45.30	x	x	x	x	x	x	x
Total stations sampled		10	16	12	16	16	16	16

Table 2. Stations sampled biweekly with CTD (conductivity, temperature, depth) meter in Penobscot Bay from April 4 through June 25, 1997.

Station	Location (Lat/long)	Sampling Trip 1	2	3	4	5	6	7
<u>Western Bay</u>								
A1(Rockland)	44.07.96/69.02.68	x	x	x	x	x	x	x
A2(Camden)	44.09.70/69.01.70	x	x	x	x	x	x	x
A3(Mt. Meg)	44.13.28/68.59.85		x	x	x		x	x
A4(Linconvil)	44.15.93/68.58.49		x	x	x		x	x
A5(Flat Is.)	44.18.37/68.57.25		x	x	x		x	x
A6(Marshall)	44.21.45/68.55.85		x	x	x	x	x	x
<u>Eastern Bay</u>								
B1(Saddle Is.)	44.10.20/68.57.18	x	x	x	x	x	x	x
B2(Compass I)	44.12.76/68.54.88	x	x	x		x	x	x
B3(Resolution)	44.15.38/68.53.47	x	x	x		x	x	
B4(C. Rosier)	44.18.92/68.51.69		x		x		x	x
B5(Castine)	44.21.62/68.50.98		x		x		x	x
B6(Sears Is.)	44.24.90/68.53.64		x	x	x		x	x
<u>North & Vinalhaven</u>								
C1(Owls H)	44.05.91/68.59.56	x		x	x	x	x	x
C2(North H)	44.11.05/68.52.81	x	x	x	x	x	x	x
C3(Deer Is.)	44.12.27/68.45.14	x	x	x	x	x	x	x
C4(Fox I Tho)	44.09.39/68.45.30		x	x	x	x	x	x
Total stations sampled		8	15	12	16	10	16	15

Table 3. Amount of water strained (cubic meters) in biweekly sampling with a 1.0 m plankton net during a 20 minute tow in Penobscot Bay from April 4 through June 25,1997.

STATION	LAT	LONG	TV	PB1	PB2	PB3	PB4	PB5	PB6	PB7	Max	Min	Mean
A1	44.08	-69.027	3394.60	359.04	329.97	619.57	755.72	286.28	652.12	391.89	755.72	286.28	484.94
A2	44.097	-69.017	3310.95	339.87	536.24	474.96	630.29	202.24	570.06	557.30	630.29	202.24	472.99
A3	44.133	-68.599	2469.80	218.06	518.04	483.97	370.43	244.35	280.23	354.72	518.04	218.06	352.83
A4	44.159	-68.585	2671.03		445.22	548.35	710.51	225.95	368.41	372.59	710.51	225.95	445.17
A5	44.184	-68.573	2835.25		558.03	516.84	620.65	416.93	388.64	334.17	620.65	334.17	472.54
A6	44.215	-68.558	2544.27		466.67	559.03	606.91	434.82	205.17	271.67	606.91	205.17	424.04
B1	44.102	-68.572	3106.98	291.50	641.87	753.08	446.99	406.55	289.45	277.55	753.08	277.55	443.85
B2	44.128	-68.549	2349.70	392.82	562.34		652.71	223.74	283.20	234.90	652.71	223.74	391.62
B3	44.154	-68.535	2003.44	290.59	485.47		591.60	280.34	137.48	217.98	591.60	137.48	333.91
B4	44.189	-68.517	2210.85		469.94		744.88	434.90	267.34	293.79	744.88	267.34	442.17
B5	44.216	-68.51	2332.05		550.31		670.16	599.89	231.82	279.87	670.16	231.82	466.41
B6	44.249	-68.536	2924.91		478.67	585.14	570.78	638.91	306.47	344.93	638.91	306.47	487.48
C1	44.059	-68.596	3452.88	485.57	585.56	596.66	597.46	508.10	348.92	330.61	597.46	330.61	493.27
C2	44.111	-68.528	2866.18	439.44	451.57	706.23	547.15	262.15	174.29	285.36	706.23	174.29	409.45
C3	44.123	-68.451	3194.04	463.51	507.64	494.96	551.98	466.38	213.02	496.56	551.98	213.02	456.29
C4	44.094	-68.453	2954.63	418.43	536.31	570.29	570.16	308.22	175.51	375.71	570.29	175.51	422.09
Max			3452.88	485.57	641.87	753.08	755.72	638.91	652.12	557.30	755.72	485.57	640.65
Min			2003.44	218.06	329.97	474.96	370.43	202.24	137.48	217.98	474.96	137.48	278.73
Mean			2788.85	369.88	507.74	575.76	602.40	371.23	305.76	338.72	602.40	305.76	438.78

Table 4. List of fishes caught by 1.0 m plankton net in Penobscot Bay from April 4 through June 25, 1997 (Number of species = 23).

Family	Species (Abbreviation)	Common name
Anguillidae	Anguilla rostrata (Aro)	American eel
Clupeidae	Clupea harengus (Cha)	Atlantic herring
Osmeridae	Mallotus villosus (Mvi)	Capelin
Gadidae	Enchelyopus cimbrius (Eci)	Four-beard rockling
	Gadus morhua (Gmo)	Atlantic cod
	Microgadus tomcod (Mto)	Atlantic tomcod
Labridae	Tautogolabrus adspersus (Tad)	Cunner
Stichaeidae	Ulvaria subbifurcata (Usu)	Radiated shanny
Pholidae	Pholis gunnellus (Pgu)	Rock gunnel
Cryptacanthodidae	Cryptacanthodes maculatus (Cma)	Wrymouth
Ammodytidae	Ammodytes sp. (Asp)	Sand lance
Scombridae	Scomber scombrus (Ssc)	Mackerel
Cottidae	Hemitriperus americanus (Ham)	Sea raven
	Myoxocephalus aenaeus (Mae)	Grubby
	M. octodecimspinosus (Moc)	Longhorn sculpin
	M. scorpius (Msc)	Shorthorn sculpin
Agonidae	Aspidophoroides monopterygius (Amo)	Alligatorfish
Cyclopteridae	Liparis atlanticus (Lat)	Sea snail
	L. coheni (Lco)	Gulf snailfish
	L. inquilinus (Lin)	Inquiline snailfish
Bothidae	Scopthalmus aquosus (Saq)	Windowpane
Pleuronectidae	Hippoglossoides platessoides (Hpl)	American plaice
	Pleuronectes americanus (Pam)	Winter flounder

Table 5. Total abundance of fishes by species by station caught by 1.0 m plankton net in Penobscot Bay from April 4 through June 25, 1997. Species abbreviations from Table 4.

STATION	*Asp*	*Aro*	*Amo*	*Cha*	*Cma*	*Eci*	*Gmo*	*Ham*	*Hpl*	*Lat*	*Lco*	*Lin*	*Lsp*	*Mvi*	*Mto*	*Mae*	*Moc*	*Msc*	*Pgu*	*Pam*	*Ssc*	*Saq*	*Tad*	*Usu*	Unk	Total
A1	6	0	0	0	1	0	0	1	1	6	0	0	0	0	0	0	1	0	1	5	0	0	0	8	0	30
A2	7	0	0	0	1	3	0	1	2	2	0	1	0	0	0	1	3	0	3	8	1	0	0	3	0	36
A3	4	0	0	0	0	1	0	0	6	1	0	0	0	0	0	2	0	0	2	3	4	0	0	11	0	34
A4	8	0	2	2	2	3	0	1	5	11	1	0	0	1	0	0	0	0	3	7	1	0	0	12	0	59
A5	19	0	0	1	5	1	0	1	1	6	0	0	0	0	0	0	0	0	2	8	1	0	0	11	1	57
A6	18	0	0	0	3	0	0	2	2	0	0	0	0	0	1	0	0	0	2	4	0	0	0	2	1	35
B1	9	0	0	0	1	1	0	4	8	7	0	0	1	0	0	0	1	0	1	10	0	0	1	31	0	75
B2	2	0	0	0	3	0	0	3	2	4	0	0	0	2	0	1	4	0	4	1	0	0	0	28	2	56
B3	8	0	0	0	4	2	0	1	5	2	0	0	0	0	0	0	2	0	3	7	0	0	0	6	2	42
B4	17	0	0	0	0	1	0	2	2	4	0	0	0	2	0	0	0	0	0	5	0	1	0	6	1	41
B5	23	2	0	0	0	0	0	0	0	6	0	0	0	4	0	1	0	0	3	3	0	0	0	2	2	46
B6	11	0	0	0	0	1	0	1	1	3	0	0	0	0	2	0	0	0	2	20	0	0	0	2	1	44
C1	8	0	0	1	0	1	1	5	2	6	0	0	0	0	0	3	2	0	3	2	0	0	1	32	0	67
C2	7	0	0	0	2	0	0	4	2	7	0	0	0	1	0	1	1	0	8	11	0	0	0	6	0	50
C3	5	0	1	0	0	1	0	2	2	9	0	0	0	0	0	0	1	2	4	2	0	0	1	17	1	48
C4	4	0	0	0	2	0	0	1	1	7	0	0	0	0	0	1	0	0	3	6	0	0	0	29	5	59
TOTAL	156	2	3	4	24	15	1	29	42	81	1	1	1	10	3	10	15	2	44	102	7	1	3	206	16	779
A sum	62	0	2	3	12	8	0	6	17	26	1	1	0	1	1	3	4	0	13	35	7	0	0	47	2	251
B sum	70	2	0	0	8	5	0	11	18	26	0	0	1	8	2	2	7	0	13	46	0	1	1	75	8	304
C sum	24	0	1	1	4	2	1	12	7	29	0	0	0	1	0	5	4	2	18	21	0	0	2	84	6	224
	Asp	*Aro*	*Amo*	*Cha*	*Cma*	*Eci*	*Gmo*	*Ham*	*Hpl*	*Lat*	*Lco*	*Lin*	*Lsp*	*Mvi*	*Mto*	*Mae*	*Moc*	*Msc*	*Pgu*	*Pam*	*Ssc*	*Saq*	*Tad*	*Usu*	Unk	Total

Table 6. Species list of larval fishes collected by 1.0 m plankton net between April and June 1997 in Penobscot Bay (n = 23) in compared with four other locations in nearshore waters of coastal Maine.

Species	Sheepscot estuary Upper (Shaw '81)	Sheepscot estuary Mouth (Chenoweth '86)	Damariscotta River (Townsend '84)	Sullivan Harbor (Townsend '84)
Anguilla rostrata	x	x	x	x
Clupea harengus	x	x	x	x
Mallotus villosus	-	-	-	-
Enchelyopus cimbrius	x	x	-	-
Gadus morhua	x	-	-	-
Microgadus tomcod	x	x	x	x
Tautogolabrus adspersus	x	x	-	-
Ulvaria subbifurcata	x	x	x	x
Pholis gunnellus	x	x	x	x
Cryptacanthodes maculatus	x	x	x	x
Ammodytes sp.	x	x	x	x
Scomber scombrus	-	-	-	-
Hemitripterus americanus	x	x	x	x
Myoxocephalus aenaeus	x	x	x	x
M. octodecimspinosus	x	x	x	x
M. scorpius	x	x	x	x
Aspidophoroides monopterygius	x	x	x	x
Liparis atlanticus	x	x	x	x
L. coheni	x	x	x	x
L. inquilinus	-	x	-	-
Scopthalmus aquosus	x	x	-	-
Hippoglossoides platessoides	x	x	-	x'
Pleuronectes americanus	x	x	x	x
Number of species collected	42	26	22	21

Species	Egg	PB1	TL (mm)	PBII	TL (mm)	PBIII	TL (mm)	PBIV	TL (mm)	PBV	TL (mm)	PBVI	TL (mm)	PBVII	TL (mm)	Total	Number
Ammodytes sp.	*D*	7	6 - 12	94	4 - 13	48	5 - 15	5	4 - 9	2	36 - 37	0		0		5	156
A. rostrata	*N*	0		1	51	0		1	60	0		0		0		2	2
A. monopterygius	*D*	0		0		1	11	1	11	0		1	10	0		3	3
C. harengus	*D*	0		2	30	0		1	38	1	36	0		0		4	4
C. maculatus	*D*	12	18 - 24	10	20 - 25	1	28	1	38	0		0		0		4	24
E. cimbrius	*P*	0		0		0		1	1	0		1	3	13	2 - 4	3	15
G. morhua	*P*	0		1	5	0		0		0		0		0		1	1
H. americanus	*D*	10	13 - 16	11	13 - 19	3	13 - 23	3	20 - 23	1	23	1	14	0		6	29
H. plattesoides	*P*	1	5	4	4 - 6	2	5 - 6	4	3 - 7	4	4 - 7	17	3 - 8	10	4 - 9	7	42
L. atlanticus	*D*	0		3	4 - 5	12	4 - 6	10	3 - 4	18	3 - 5	17	3 - 5	21	2 - 7	6	81
L. coheni	*D*	0		1	14	0		0		0		0		0		1	1
L. imquilinus	*D*	0		0		1	5	0		0		0		0		1	1
M. villosus	*D*	0		0		0		0		8	5 - 7	2	6 - 7	0		2	10
M. tomcod	*D*	0		3	6 - 7	0		0		0		0		0		1	3
M. aenaeus	*D*	1	6	5	6 - 19	4	5 - 9	0		0		0		0		3	10
M. octodecimspinosus	*D*	13	5 - 12	1	11	1	13	0		0		0		0		3	15
M. scorpius	*D*	2	13	0		0		0		0		0		0		1	2
P. gunnellus	*D*	19	13 - 17	15	13 - 20	7	5 - 22	1	25	1	14	1	13	0		6	44
P. americanus	*D*	0		1	2	20	2 - 4	24	2 - 5	16	3 - 5	17	3 - 6	24	3 - 7	6	102
S. scombrus	*P*	0		0		0		0		0		0		7	2 - 3	1	7
S. aquosus	*P*	0		0		0		0		0		0		1	3	1	1
T. adspersus	*P*	0		0		0		0		0		0		3	2	1	3
U. subbifurcata	*D*	0		0		0		8	6 - 7	21	5 - 7	54	5 - 8	123	5 - 10	4	206

Table 7. Egg type and total length of larval fishes by sample date caught by 1.0 m plankton net in Penobscot Bay from April 4 through June 25, 1997.

Table 8. Stations sampled using 1.0 m beam trawl in Penobscot Bay from August 25 through September 9, 1997. (Day = Aug 25 - 27, N1 = Sep 2 - 3 night, and N2 = Sep 8 - 9 night).

Station	Location (Lat/long)	Depth (m)	Substrate	Temp (C)	Sampling Trip Day	N1	N2
Sheep Is. (SI)	44.04.21/69.02.82	2 - 4	cobble	12.0	x		
Owls Head (OH)	44.05.70/69.02.88	2 - 5	gravel	12.2	x	x	x
700 Acre Is. (SA)	44.14.86/68.57.00	2 - 3	sand/gravel	15.2	x		
Lincolnville (LB)	44.16.76/60.00.27	2 - 5	sand/eelgrass	14.8	x		x
Saturday Cv. (SC)	44.20.34/68.57.01	3 - 5	sand/gravel	17.3	x	x	
Marshall Pt. (MP)	44.25.50/68.54.17	2 - 3	sand	16.3	x	x	x
Coombes Cv. (CC)	44.20.76/68.52.25	2 - 3	cobble	15.0	x		
Gull Point (GP)	44.14.86/68.54.66	3 - 7	gravel/kelp	15.0	x	x	x
Resolution Is. (RI)	44.15.57/68.51.43	3 - 5	cobble/rock	16.0	x		
Beach Is. (BI)	44.15.44/68.48.92	2 - 5	sand/eelgrass	16.4	x		x
Eagle Is. (EI)	44.12.99/68.46.80	2 - 5	sand/gravel	12.4	x	x	
Webster Head (WH)	44.11.04/68.50.24	3 - 5	sand	16.4	x	x	x
Widow Is. (WI)	44.07.90/68.49.90	2 - 4	gravel/rock	12.6	x		
Wooster Cove (WC)	44.07.52/68.56.04	3 - 4	cobble	16.0	x		
Total stations sampled					14	6	6
Total number of tows					42	18	18

Table 9. Species list of larval fishes collected by 1.0 m plankton net between April and June 1997 and juvenile fishes collected with 1.0 m beam trawl in Penobscot Bay in August and September1997 (Total number of species = 29).

Family Species (Abbreviation)	Common name	Larvae	Juvenile
Anguillidae			
Anguilla rostrata (Aro)	American eel	x	
Clupeidae			
Clupea harengus (Cha)	Atlantic herring	x	x
Osmeridae			
Mallotus villosus (Mvi)	Capelin	x	
Gadidae			
Enchelyopus cimbrius (Eci)	Four-beard rockling	x	
Gadus morhua (Gmo)	Atlantic cod	x	
Microgadus tomcod (Mto)	Atlantic tomcod	x	
Urophycis tenuis (Ute)	White hake		x
Atherinidae			
Menidia menidia (Mme)	Atlantic silverside		x
Gasterosteidae			
Apeltes quadracus (Aqu)	Fourspined stickleback		x
Gasterosteus aculeatus (Gad)	Threespined stickleback		x
Pungitius pungitius (Ppu)	Ninespined stickleback		x
Labridae			
Tautogolabrus adspersus (Tad)	Cunner	x	x
Stichaeidae			
Ulvaria subbifurcata (Usu)	Radiated shanny	x	
Pholidae			
Pholis gunnellus (Pgu)	Rock gunnel	x	x
Cryptacanthodeidae			
Cryptacanthodes maculatus (Cma)	Wrymouth	x	
Ammodytidae			
Ammodytes sp. (Asp)	Sand launce	x	x

Scombridae			
Scomber scombrus (Ssc)	Mackerel	x	
Cottidae			
Hemitriperus americanus (Ham)	Sea raven	x	x
Myoxocephalus aenaeus (Mae)	Grubby	x	x
M. octodecimspinosus (Moc)	Longhorn sculpin	x	
M. scorpius (Msc)	Shorthorn sculpin	x	
Agonidae			
Aspidophoroides monopterygius (Amo)	Alligatorfish	x	
Cyclopteridae			
Cyclopterus lumpus (Clu)	Lumpfish		x
Liparis atlanticus (Lat)	Sea snail	x	x
L. coheni (Lco)	Gulf snailfish	x	x
L. inquilinus (Lin)	Inquiline snailfish	x	
Bothidae			
Scopthalmus aquosus (Saq)	Windowpane	x	
Pleuronectidae			
Hippoglossoides platessoides (Hpl)	American plaice	x	x
Pleuronectes americanus (Pam)	Winter flounder	x	x
Number of species collected		23	16

Table 10. Abundance of juvenile fishes and decapod crustaceans collected with 1.0 m beam trawl in Penobscot Bay in August and September1997. (Total number of species = 21, 16 fishes and five decapods).

Species (Abbreviation)	Common name	Abundance Day	Night	Total
Crangon septemspinosa (Cse)	Sand shrimp	3183	4386	7569
Carcinus maenas (Cam)	Green crab	64	123	187
Pandalus sp. (Psp)	Shrimp	60	90	150
Myoxocephalus aenaeus (Mae)	Grubby	2	51	53
Cyclopterus lumpus (Clu)	Lumpfish	18	20	38
Pleuronectes americanus (Pam)	Winter flounder	3	32	35
Gasterosteus aculeatus (Gad)	Threespine stickleback	5	15	20
Cancer sp. (Csp)	Cancer crab	3	17	20
Clupea harengus (Cha)	Atlantic herring	0	16	16
Ammodytes sp. (Asp)	Sand lance	3	10	13
Pholis gunnellus (Pgu)	Rock gunnel	0	7	7
Hemitriperus americanus (Ham)	Sea raven	2	3	5
Liparis atlanticus (Lat)	Sea snail	0	4	4
Hippoglossoides platessoides (Hpl)	American plaice	2	0	2
L. coheni (Lco)	Gulf snailfish	0	2	2
Menidia menidia (Mme)	Atlantic silverside	0	2	2
Tautogolabrus adspersus (Tad)	Cunner	0	2	2
Apeltes quadracus (Aqu)	Fourspine stickleback	1	0	1
Homarus americanus (Ham)	Lobster	0	1	1
Pungitius pungitius (Ppu)	Ninespine stickleback	0	1	1
Urophycis tenuis (Ute)	White hake	0	1	1
Total		3346	4783	8129

Table 11. Abundance of juvenile fishes and decapod crustaceans by station and habitat type with 1.0 m beam trawl in Penobscot Bay in August and September1997. Species abbreviations as noted in Table 4.

	Fishes																Decapods						
STATION	*Asp*	*Aqu*	*Gad*	*Clu*	*Cha*	*Ham*	*Hpl*	*Lat*	*Lco*	*Ppu*	*Mae*	*Mme*	*Pgu*	*Pam*	*Tad*	*Ute*	*Cbo*	*Cam*	*Cse*	*Hoa*	*Psp*	*Total*	*#Sp*
GP	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	1	297	0	0	301	5
WI	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	3	0	0	5	3
GP	0	0	0	0	0	1	1	0	0	0	5	0	0	7	0	1	0	0	155	0	30	200	7
GP	0	0	0	0	0	0	0	1	0	0	2	0	0	1	0	0	0	0	60	0	30	94	5
Gravel	0	0	0	2	0	2	2	1	0	0	8	0	0	8	0	1	0	1	515	0	60	600	10
CC	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	22	435	0	0	458	3
WC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	30	0	39	70	3
SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	7	15	0	21	44	4
RI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	190	0	0	195	4
Cobble	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	35	670	0	60	767	5
BI	0	0	0	6	0	1	0	0	0	0	0	0	0	0	0	0	1	2	211	0	0	221	5
LB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	19	0	0	20	2
OH	0	0	1	2	0	0	0	0	1	0	0	0	0	0	0	0	0	9	64	0	0	77	5
OH	0	0	0	5	0	0	0	0	1	0	12	0	2	3	0	0	5	48	125	0	0	201	8
LB	0	0	1	0	0	0	0	0	0	0	2	0	1	1	0	0	1	0	125	1	0	132	7
OH	1	0	0	0	0	0	0	2	0	0	29	0	2	1	0	0	5	8	50	0	30	128	9
BI	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	9	81	0	0	92	4
Eelgrass	1	0	2	14	0	1	0	2	2	0	44	0	5	5	0	0	12	77	675	1	30	871	14
WH	1	1	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	475	0	0	480	5
SA	1	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	9	97	0	0	113	4
SC	0	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	1	307	0	0	311	4
MP	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	700	0	0	705	3
EI	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	340	0	0	346	4
SC	0	0	1	1	2	0	0	0	0	0	0	0	1	5	1	0	5	1	990	0	0	1007	9
MP	0	0	13	1	14	0	0	0	0	0	0	2	0	9	1	0	0	25	1580	0	0	1645	8
WH	4	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	165	0	0	172	4
EI	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	6	305	0	0	315	6
MP	3	0	0	12	0	0	0	0	0	1	0	0	1	2	0	0	0	24	540	0	0	583	7
WH	1	0	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	0	210	0	0	214	4
Sand	12	1	18	22	16	2	0	1	0	1	0	2	2	22	2	0	7	74	5709	0	0	5891	15
TOTAL	13	1	20	38	16	5	2	4	2	1	53	2	7	35	2	1	20	187	7569	1	150	8129	21

Table 12. Abundance of juvenile fishes and decapod crustaceans by station and time of collection with 1.0 m beam trawl in Penobscot Bay in August and September1997. Species abbreviations as noted in Table 4.

	Fishes																Decapods						
STATION	*Asp*	*Aqu*	*Gad*	*Clu*	*Cha*	*Ham*	*Hpl*	*Lat*	*Lco*	*Ppu*	*Mae*	*Mme*	*Pgu*	*Pam*	*Tad*	*Ute*	*Cbo*	*Cam*	*Cse*	*Hoa*	*Psp*	*Total*	*#Sp*
GP	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	1	297	0	0	301	5
RI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	190	0	0	195	4
BI	0	0	0	6	0	1	0	0	0	0	0	0	0	0	0	0	1	2	211	0	0	221	5
WH	1	1	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	475	0	0	480	5
SA	1	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	9	97	0	0	113	4
LB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	19	0	0	20	2
SC	0	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	1	307	0	0	311	4
MP	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	700	0	0	705	3
CC	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	22	435	0	0	458	3
WC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	30	0	39	70	3
SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	7	15	0	21	44	4
WI	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	3	0	0	5	3
EI	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	340	0	0	346	4
OH	0	0	1	2	0	0	0	0	1	0	0	0	0	0	0	0	0	9	64	0	0	77	5
DAY SUM	3	1	5	18	0	2	1	0	1	0	2	0	0	3	0	0	3	64	3183	0	60	3346	14
Night #1																							
SC	0	0	1	1	2	0	0	0	0	0	0	0	1	5	1	0	5	1	990	0	0	1007	9
MP	0	0	13	1	14	0	0	0	0	0	0	2	0	9	1	0	0	25	1580	0	0	1645	8
OH	0	0	0	5	0	0	0	0	1	0	12	0	2	3	0	0	5	48	125	0	0	201	8
WH	4	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	165	0	0	172	4
EI	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	6	305	0	0	315	6
GP	0	0	0	0	0	1	1	0	0	0	5	0	0	7	0	1	0	0	155	0	30	200	7
N#1 Sum	5	0	14	7	16	2	1	1	1	0	17	2	3	25	2	1	11	82	3320	0	30	3540	18
Night #2																							
MP	3	0	0	12	0	0	0	0	0	1	0	0	1	2	0	0	0	24	540	0	0	583	7
LB	0	0	1	0	0	0	0	0	0	0	2	0	1	1	0	0	1	0	125	1	0	132	7
OH	1	0	0	0	0	0	0	2	0	0	29	0	2	1	0	0	5	8	50	0	30	128	9
BI	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	9	81	0	0	92	4
GP	0	0	0	0	0	0	0	1	0	0	2	0	0	1	0	0	0	0	60	0	30	94	5
WH	1	0	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	0	210	0	0	214	4
N#2 Sum	5	0	1	13	0	1	0	3	0	1	34	0	4	7	0	0	6	41	1066	1	60	1243	14
Night Sum	10	0	15	20	16	3	1	4	1	1	51	2	7	32	2	1	17	123	4386	1	90	4783	20
TOTAL	13	1	20	38	16	5	2	4	2	1	53	2	7	35	2	1	20	187	7569	1	150	8129	21

Table 13. Utilization of Penobscot Bay by fishes and decapod crustaceans from August - September 1997. Habitat utilization as follows: Gr = gravel, Co = cobbles, Eg = eelgrass and Sa = sand.

Family Species	Mode of Utilization	Habitat Gr	 Co	 Eg	 Sa	Life History Stage
Anguillidae						
Anguilla rostrata	Catadromous					larvae
Clupeidae						
Clupea harengus	Nursery				x	larvae, brit
Osmeridae						
Mallotus villosus	Transient					larvae
Gadidae						
Enchelyopus cimbrius	Resident					larvae
Gadus morhua	Resident?					larvae
Microgadus tomcod	Resident					larvae
Urophycis tenuis	Nursery	x				juvenile
Atherinidae						
Menidia menidia	Nursery				x	adult
Gasterosteidae						
Apeltes quadracus	Resident				x	adult
Gasterosteus aculeatus	Resident			x	x	adult
Pungitius pungitius	Resident				x	adult
Labridae						
Tautogolabrus adspersus	Resident				x	larvae, juvenile
Stichaeidae						
Ulvaria subbifurcata	Resident					larvae
Pholidae						
Pholis gunnellus	Resident			x	x	larvae-adult
Cryptacanthodeidae						
Cryptacanthodes maculatus	Resident					larvae
Ammodytidae						
Ammodytes sp.	Resident			x	x	larvae-adult

Scombridae						
Scomber scombrus	Transient					larvae
Cottidae						
Hemitriperus americanus	Resident	x		x	x	larvae, juvenile
Myoxocephalus aenaeus	Resident	x	x	x		larvae-adult
M. octodecimspinosus	Resident					larvae
M. scorpius	Resident					larvae
Agonidae						
Aspidophoroides monopterygius	Resident					larvae
Cyclopteridae						
Cyclopterus lumpus	Nursery	x		x	x	juvenile
Liparis atlanticus	Resident	x		x	x	larvae, adult
L. coheni	Resident			x		larvae, adult
L. inquilinus	Transient?					larvae
Bothidae						
Scopthalmus aquosus	Resident					larvae
Pleuronectidae						
Hippoglossoides platessoides	Resident	x				larvae, juvenile
Pleuronectes americanus	Resident	x		x	x	larvae-adult
Decapoda						
Cancer sp.	Resident		x	x	x	juvenile, adult
Carcinus maenas	Resident	x	x	x	x	juvenile, adult
Crangon septemspinosus	Resident	x	x	x	x	juvenile, adult
Homarus americanus	Resident			x		juvenile
Pandalus sp.	Resident	x	x	x		juvenile

Table 14. Comparison of fish species (n = 16) collected in Penobscot Bay with 1.0 m beam trawl from August - September 1997 with three Maine estuarine studies.

Family Species	Montsweag Bay (Targett & McCleave, 1974)	Sagadahoc Bay (Lazzari et al., in press)	Wells Harbor (Ayvazian et al., 1992)
Clupeidae			
Clupea harengus	x	x	x
Gadidae			
Urophycis tenuis	x	x	x
Atherinidae			
Menidia menidia	x	x	x
Gasterosteidae			
Apeltes quadracus	x	x	x
Gasterosteus aculeatus	x	x	x
Pungitius pungitius	x	x	x
Labridae			
Tautogolabrus adspersus	-	-	x
Pholidae			
Pholis gunnellus	-	-	x
Ammodytidae			
Ammodytes sp.	-	x	x
Cottidae			
Hemitriperus americanus	-	x	-
Myoxocephalus aenaeus	-	-	x
Cyclopteridae			
Cyclopterus lumpus	-	x	x
Liparis atlanticus	-	-	-
L. coheni	-	-	-
Pleuronectidae			
Hippoglossoides platessoides	-	-	-
Pleuronectes americanus	x	x	x
Number of species	18	26	24
Species in common	7	10	12

List of Figures

Figure 12. Number of species by by egg type and sample date in biweekly sampling with a 1.0 m plankton net during 20 minute tows in Penobscot Bay from April 4 through June 25,1997.

Figure 13. Number of larvae collected by egg type and station in biweekly sampling with a 1.0 m plankton net during 20 minute tows in Penobscot Bay from April 4 through June 25,1997.

Figure 14. Map of stations sampled biweekly by 1.0 m beam trawl in Penobscot Bay from April 4 through June 25, 1997.

Figure 15. Number of fishes and decapod species collected by habitat with 1.0 m beam trawl in Penobscot Bay from August - September, 1997.

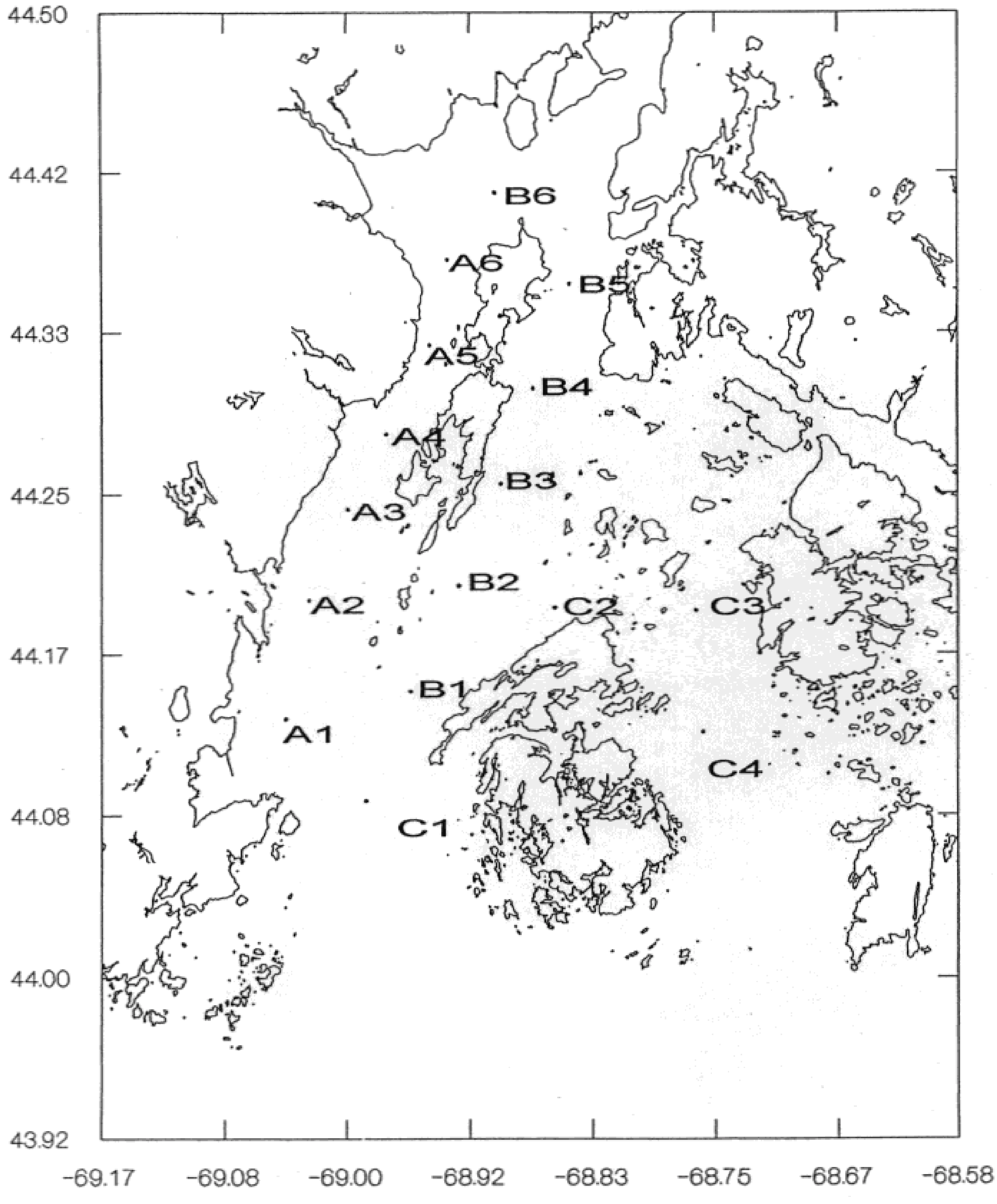
Figure 16. Abundance of fishes and decapod (natural log of number) collected by habitat with 1.0 m beam trawl in Penobscot Bay from August - September, 1997.

Figure 17. Number of fishes and decapod species collected by time of day with 1.0 m beam trawl in Penobscot Bay from August - September, 1997.

Figure 18. Abundance of fishes and decapod (natural log of number) collected by time of day with1.0 m beam trawl in Penobscot Bay from August - September, 1997.

Figure 19. Total length of the more common fishes caught by 1.0 m beam trawl in Penobscot Bay August and September, 1997.

Figure 1. Map of stations sampled biweekly by 1.0 m plankton net in Penobscot Bay from April 4 through June 25, 1997.



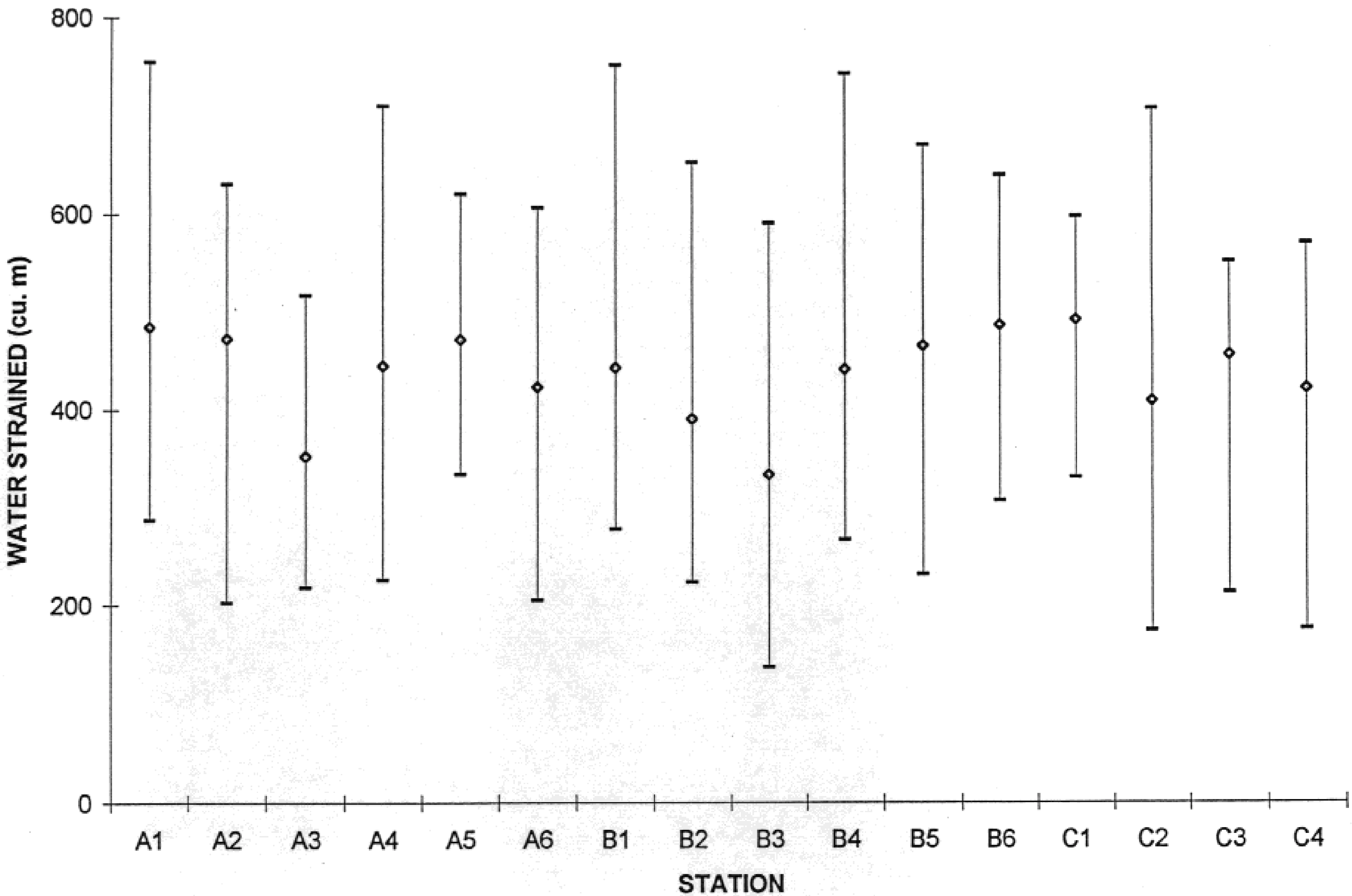


Figure 2. Total amount of water strained by station in cubic meters in biweekly sampling with a 1.0 m plankton net during 20 minute tows in Penobscot Bay from April 4 through June 25,1997.

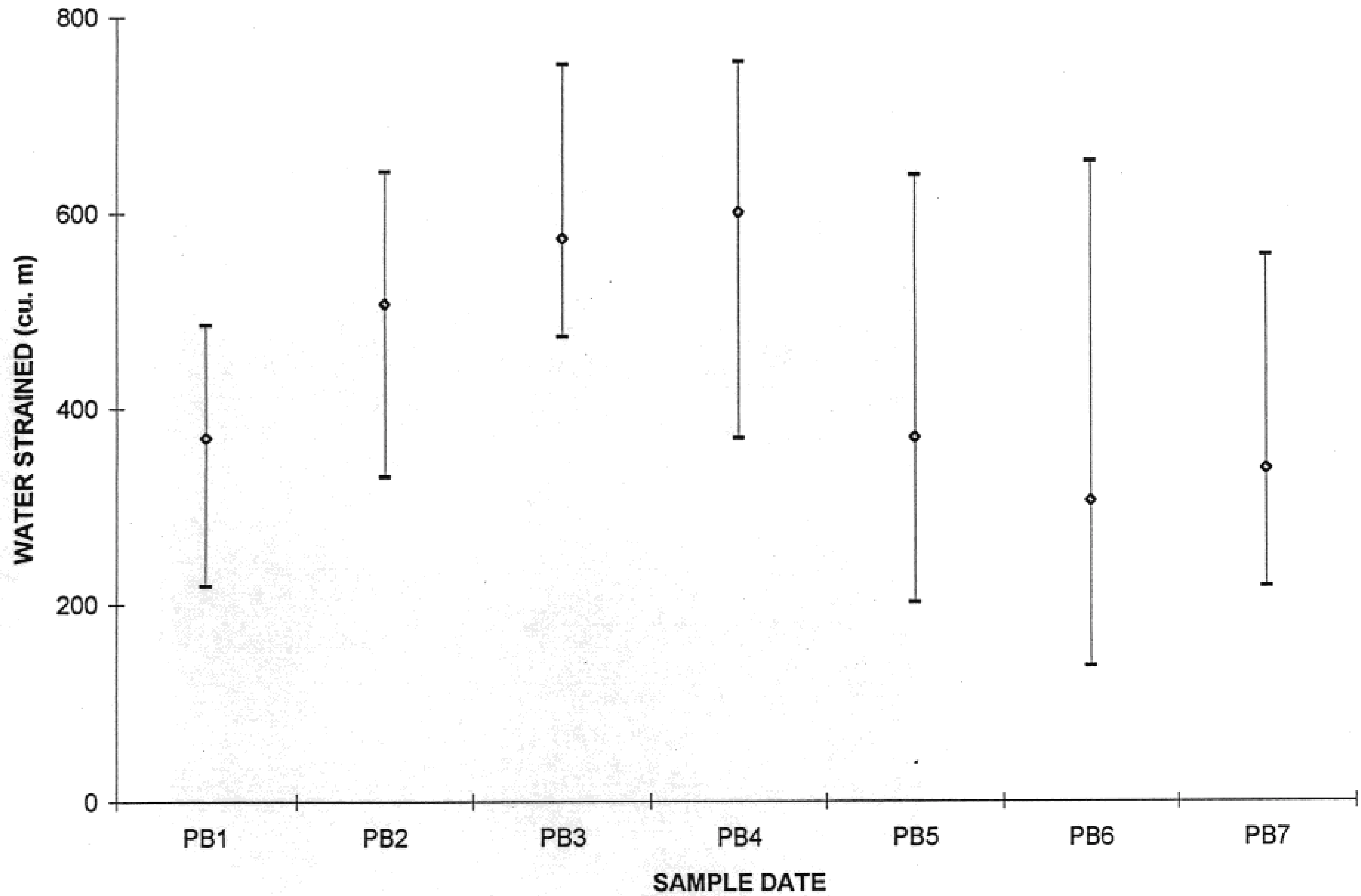
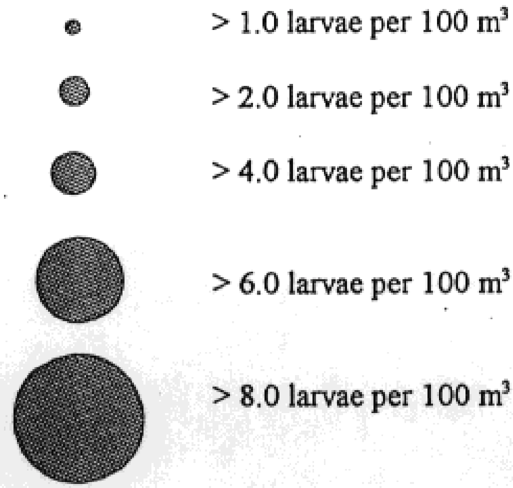


Figure 3. Total amount of water strained by sample date in cubic meters in biweekly sampling with a 1.0 m plankton net during 20 minute tows in Penobscot Bay from April 4 through June 25,1997.

Figure legend showing densities of larvae per 100 m³ used in Figures 4 - 8.



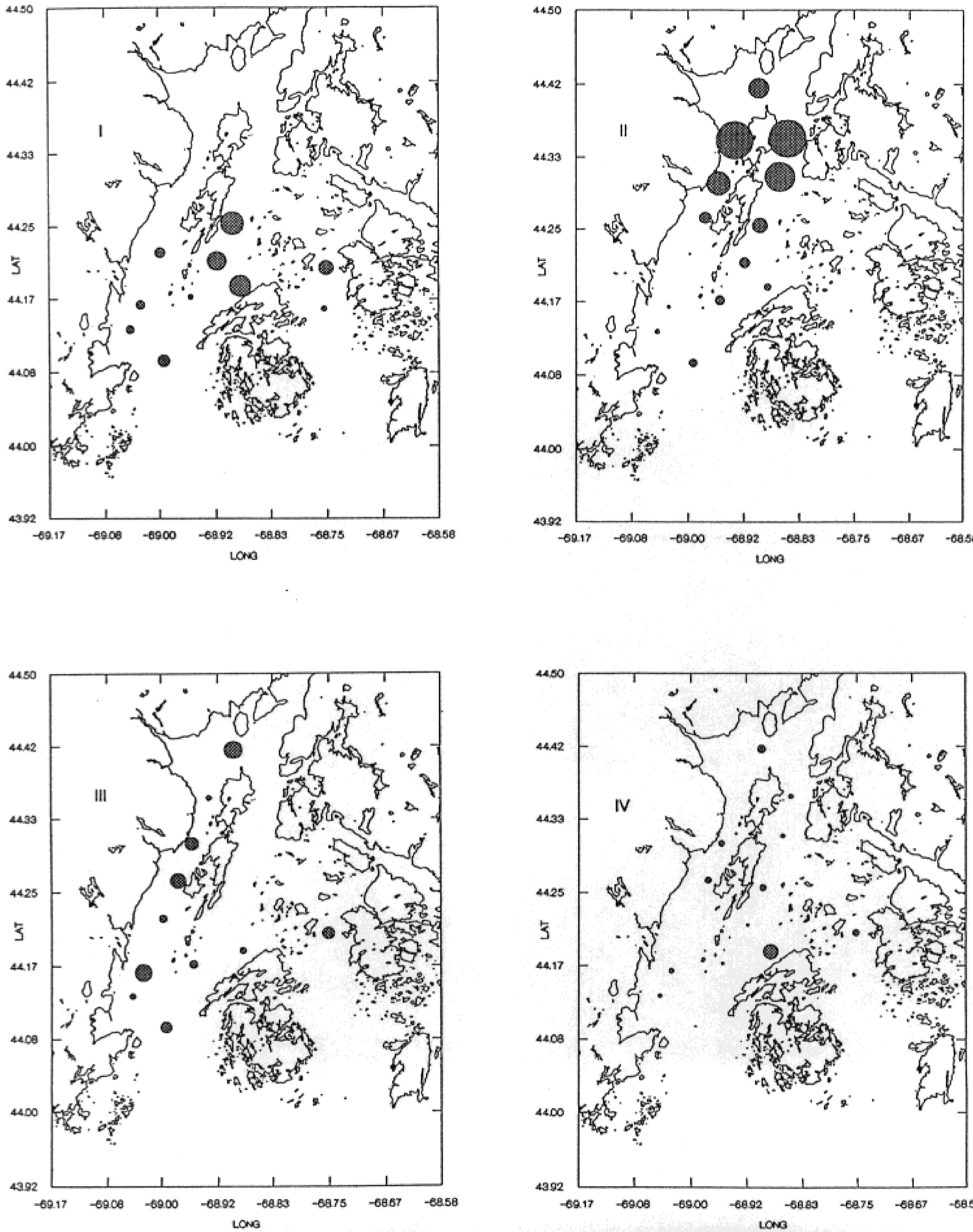


Figure 4. Density of fish larvae (number per 100 m³) by sample date in biweekly sampling

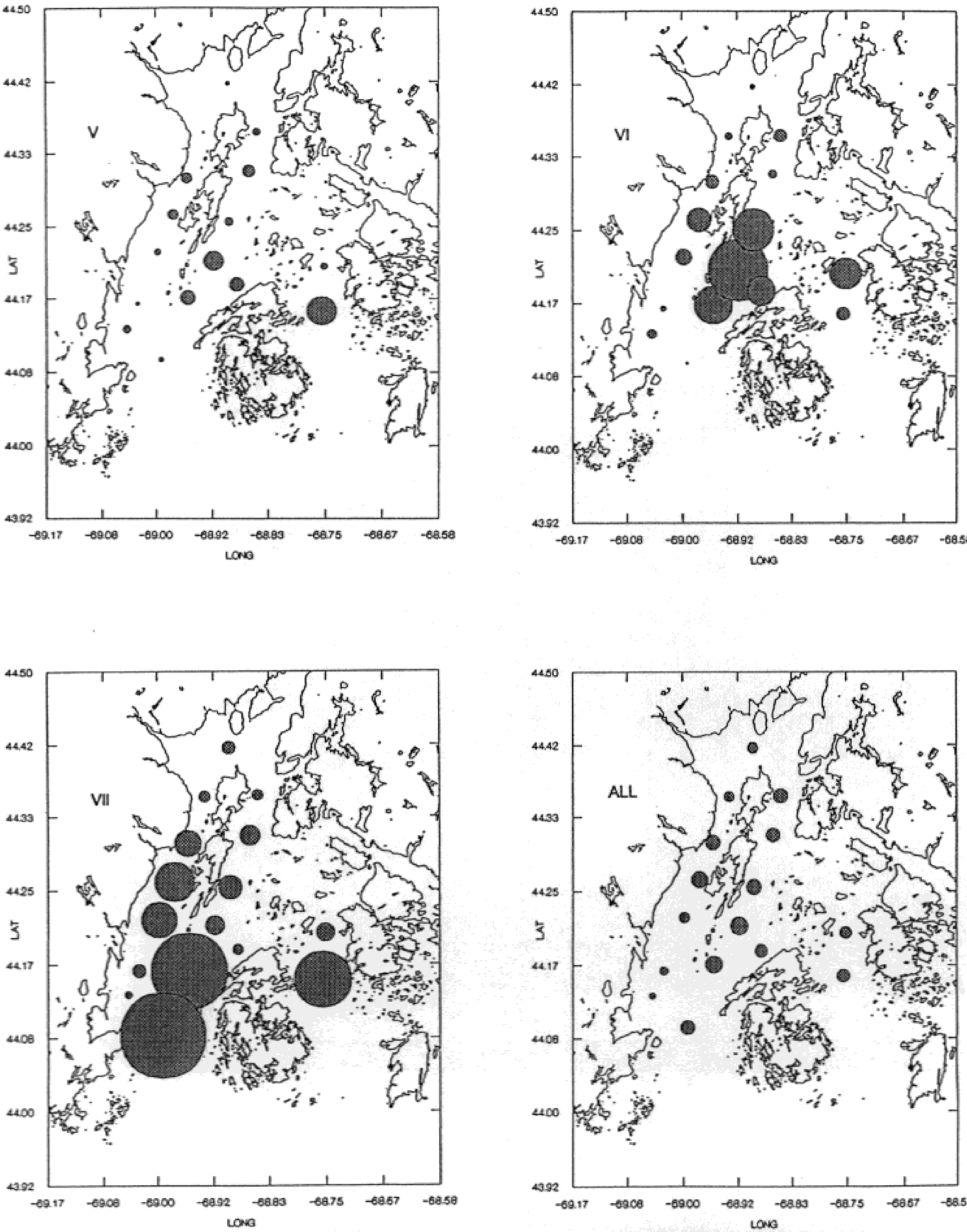
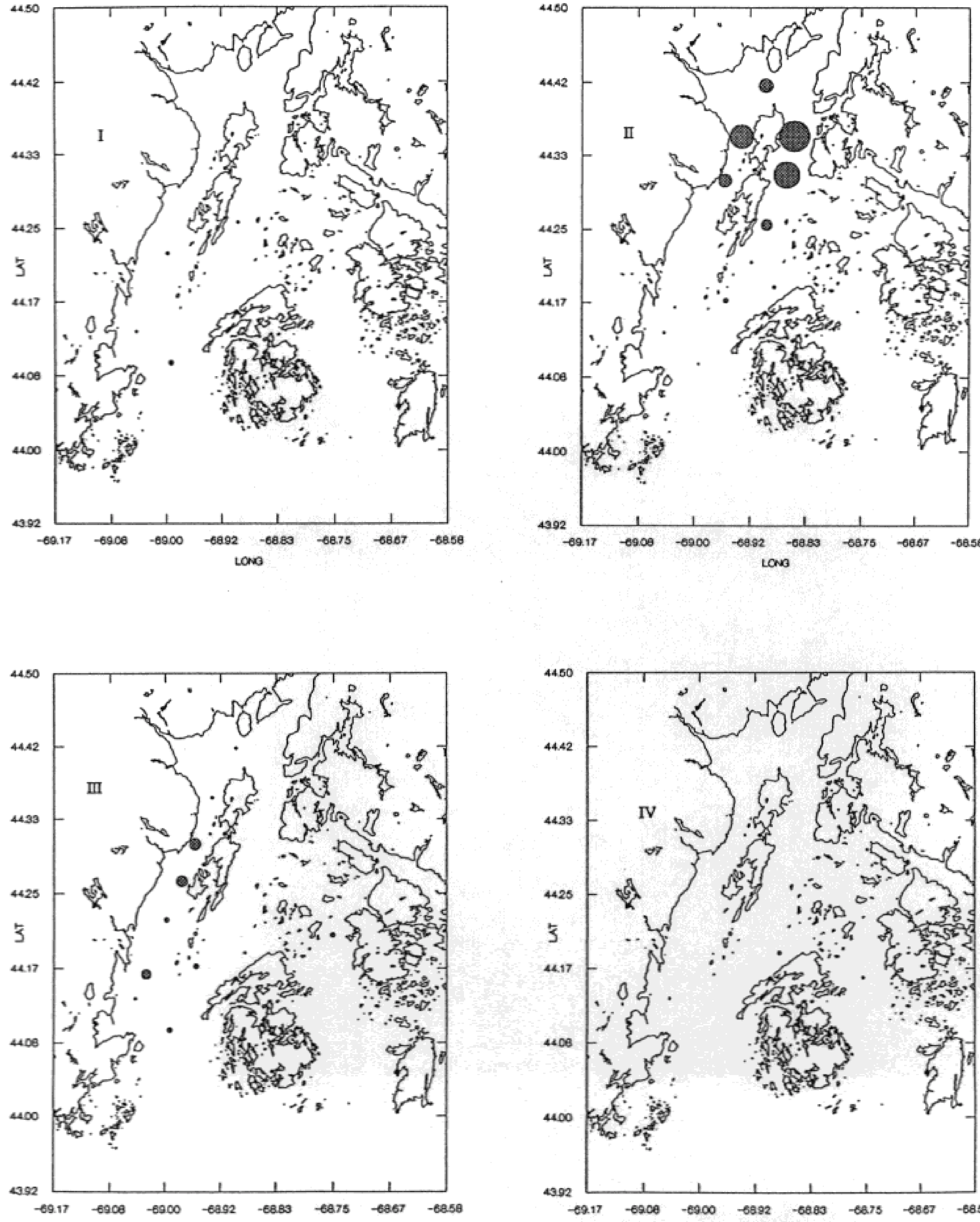
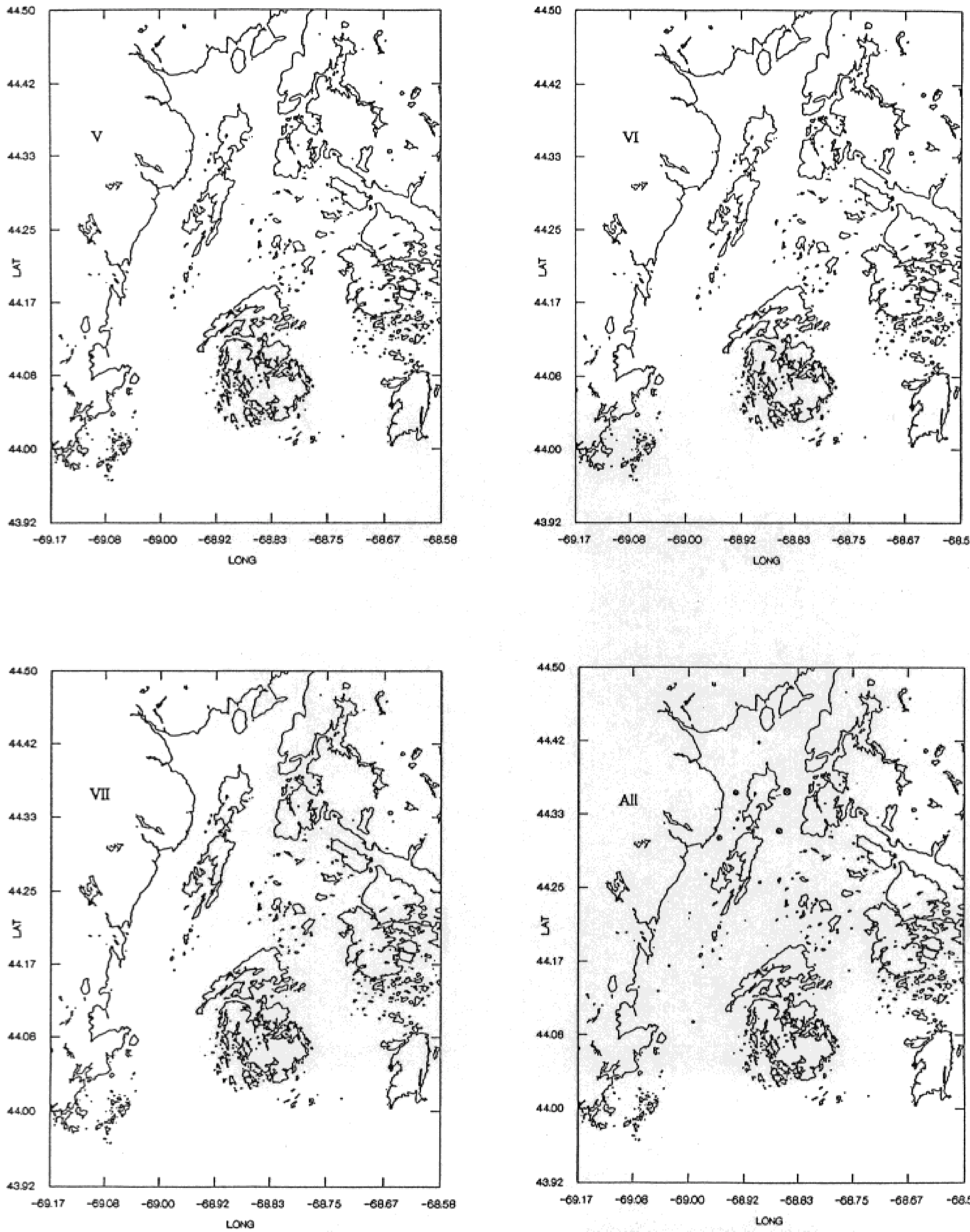

V
VI
VII
ALL
LAT
LONG
44.50
44.42
44.33
44.25
44.17
44.08
44.00
43.92
-69.17
-69.08
-69.00
-68.92
-68.83
-68.75
-68.67
-68.58

Figure 4


I
II
III
IV
LAT
LONG
44.50
44.42
44.33
44.25
44.17
44.08
44.00
43.92
-69.17
-69.08
-69.00
-68.92
-68.83
-68.75
-68.67
-68.58



V
VI
VII
All
LAT
LONG
44.50
44.42
44.33
44.25
44.17
44.08
44.00
43.92
-69.17
-69.08
-69.00
-68.92
-68.83
-68.75
-68.67
-68.58

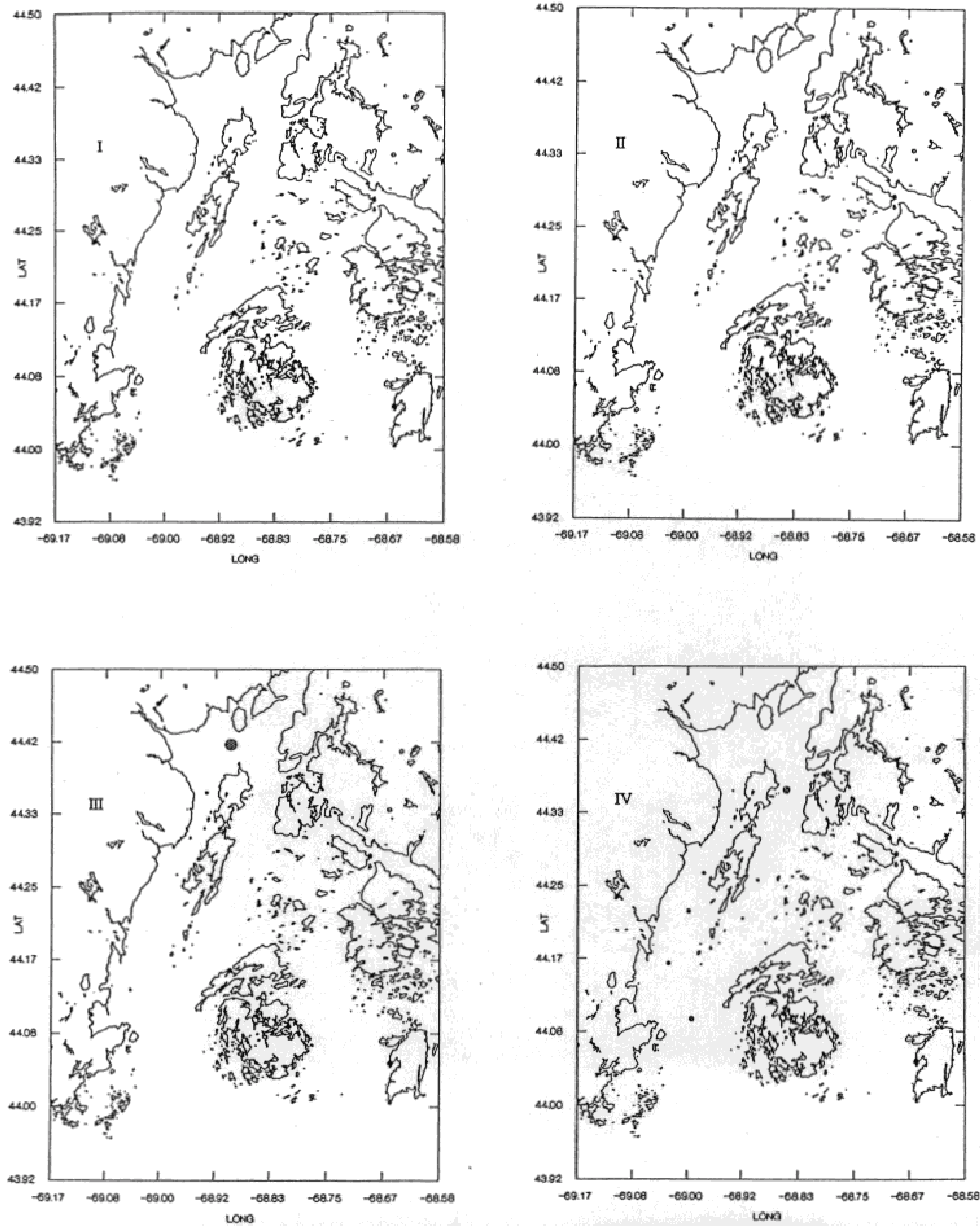
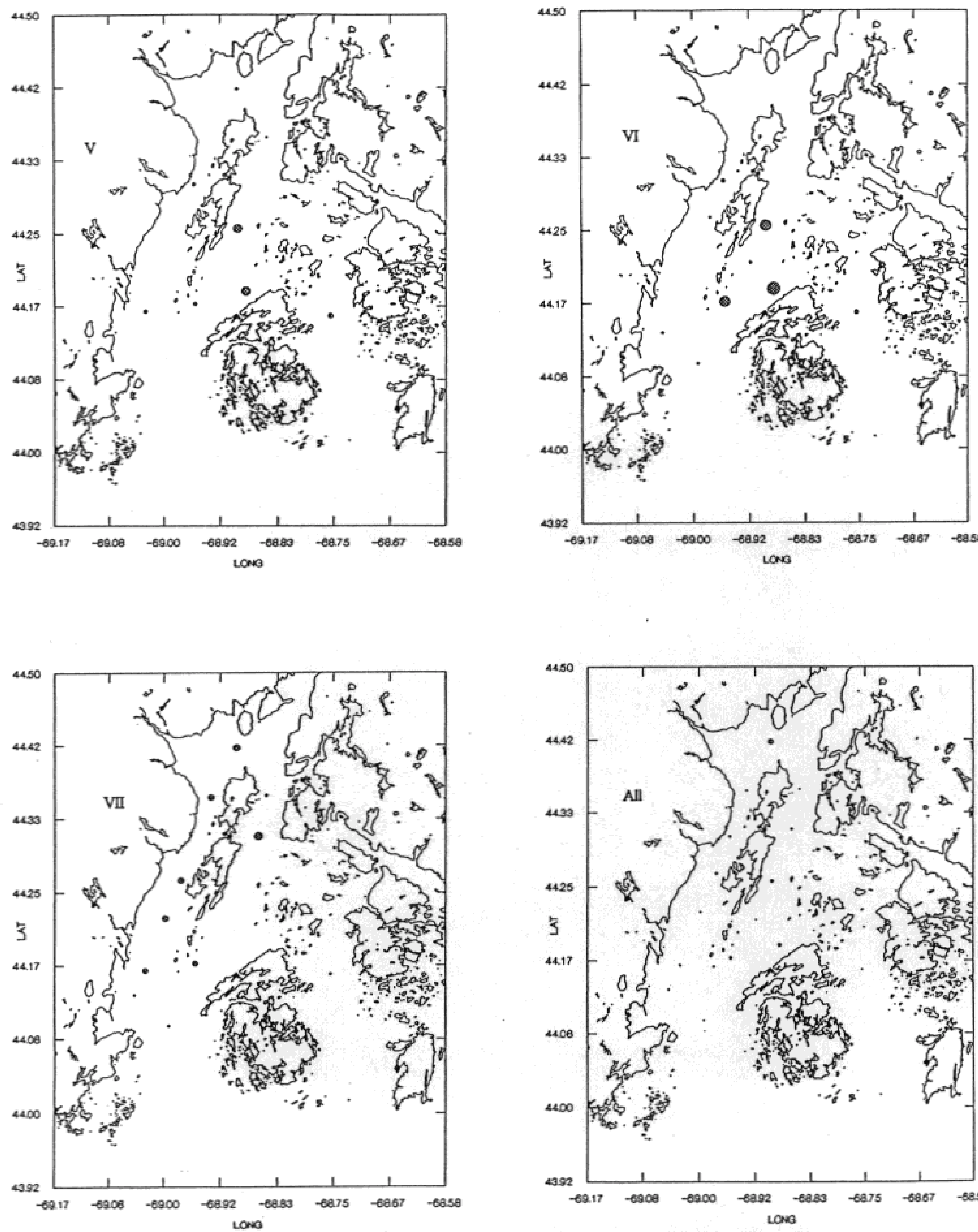


Figure 6. Density of winter flounder (Pleuronectes americanus) larvae (number per 100


V
VI
VII
All
LAT
LONG
44.50
44.42
44.33
44.25
44.17
44.08
44.00
43.92
-69.17
-69.08
-69.00
-68.92
-68.83
-68.75
-68.67
-68.58

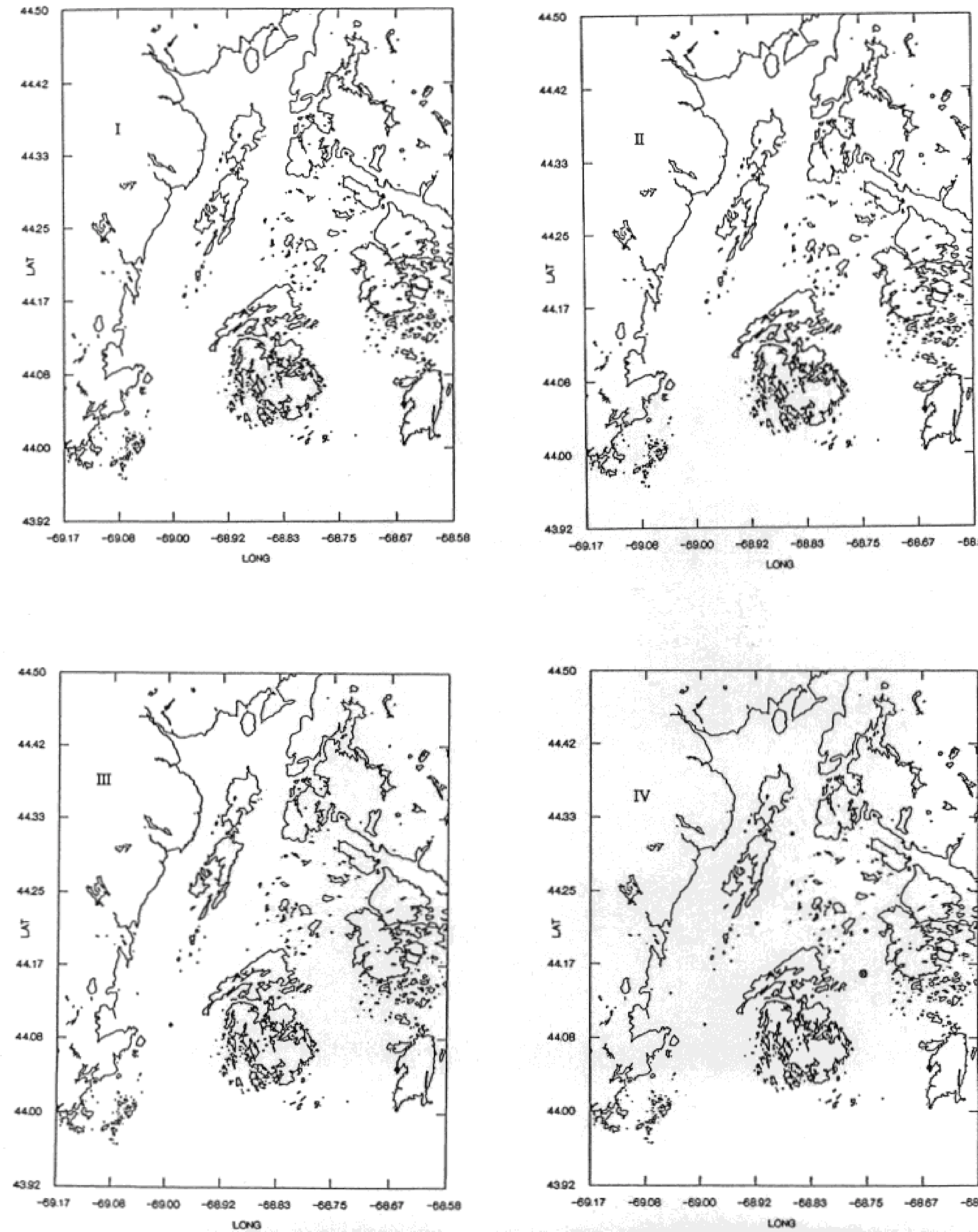
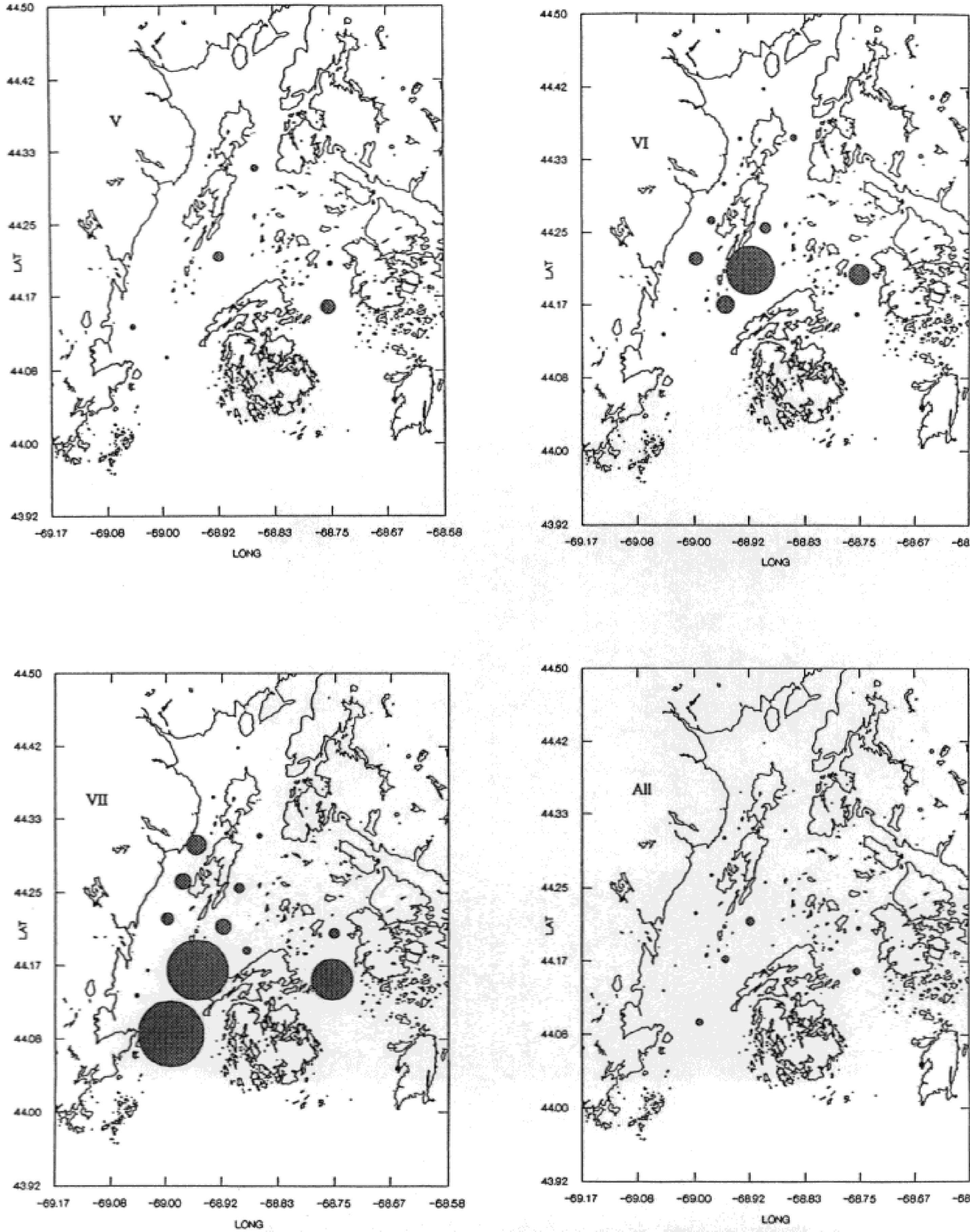
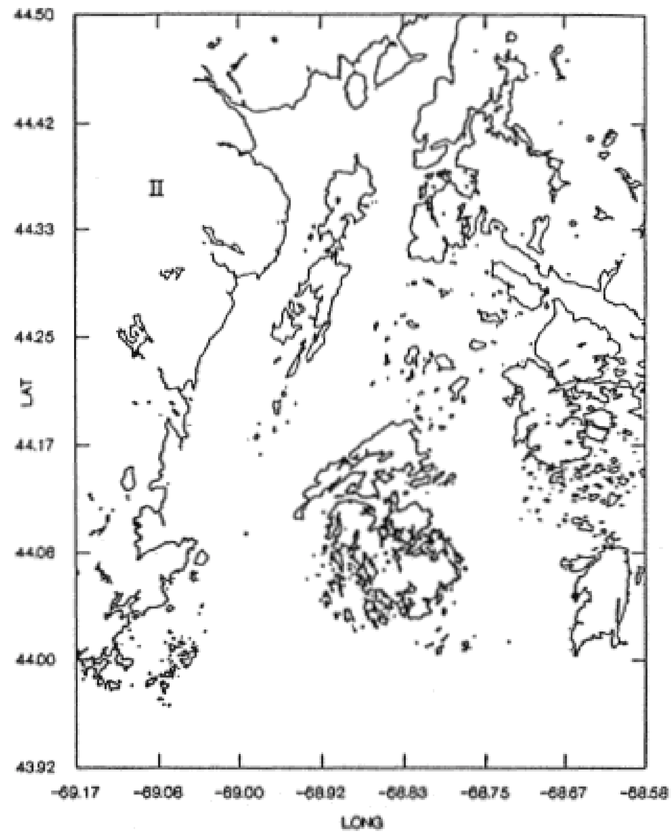


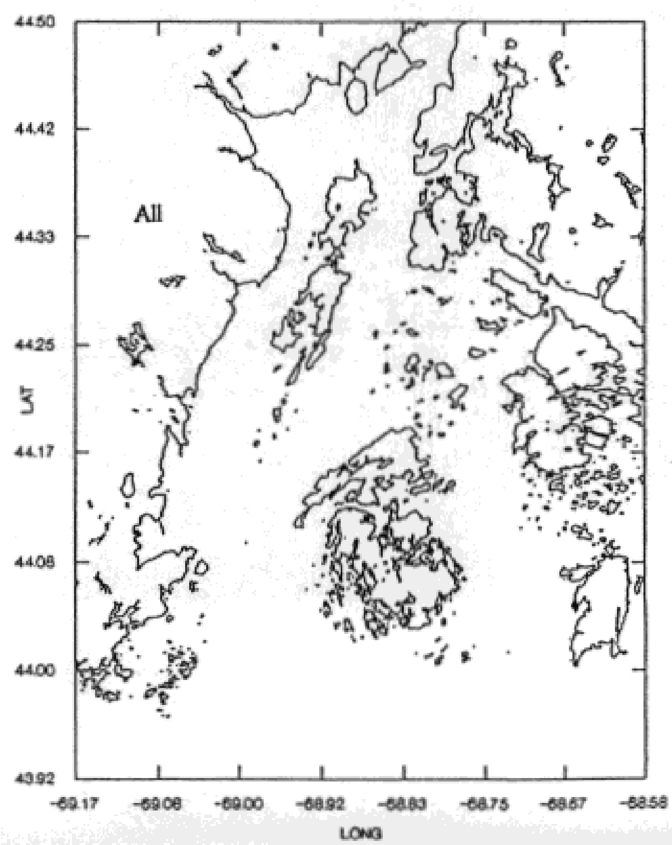
Figure 7. Density of radiated shanny (Ulvaria subbifurcata) larvae (number per 100



V
VI
VII
All
LAT
LONG
44.50
44.42
44.33
44.25
44.17
44.08
44.00
43.92
-69.17
-69.08
-69.00
-68.92
-68.83
-68.75
-68.67
-68.58

(No cod larvae collected during PBI, PBIII - PBVII).





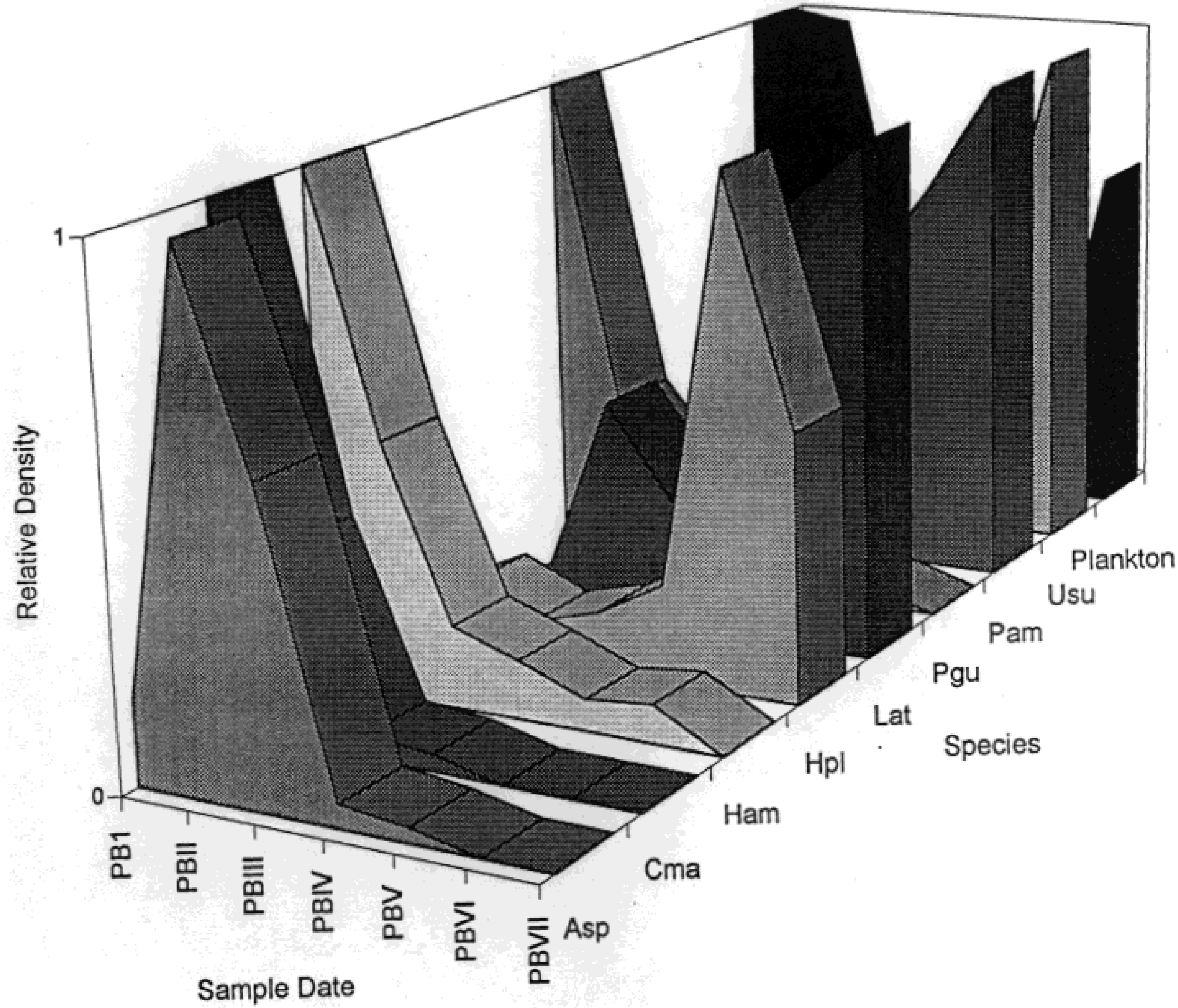


Figure 9. Relative density of the more common species of larvae and plankton volume by sample date in biweekly sampling with a 1.0 m plankton net during 20 minute tows in Penobscot Bay from April 4 through June 25,1997.

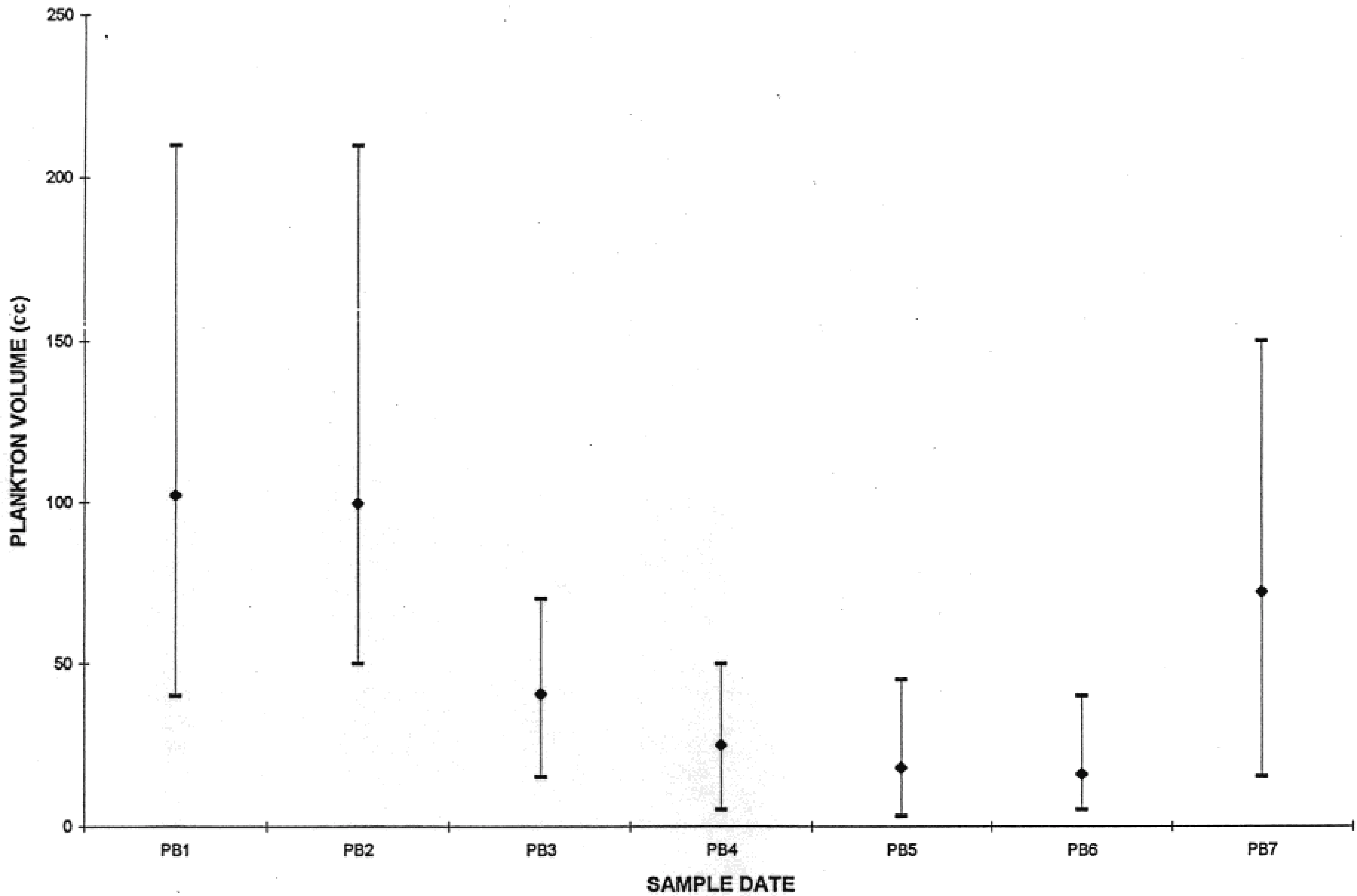


Figure 10. Total plankton volume (cc) by sample date in biweekly sampling with a 1.0 m plankton net during 20 minute tows in Penobscot Bay from April 4 through June 25,1997.

Sheet1 Chart 2

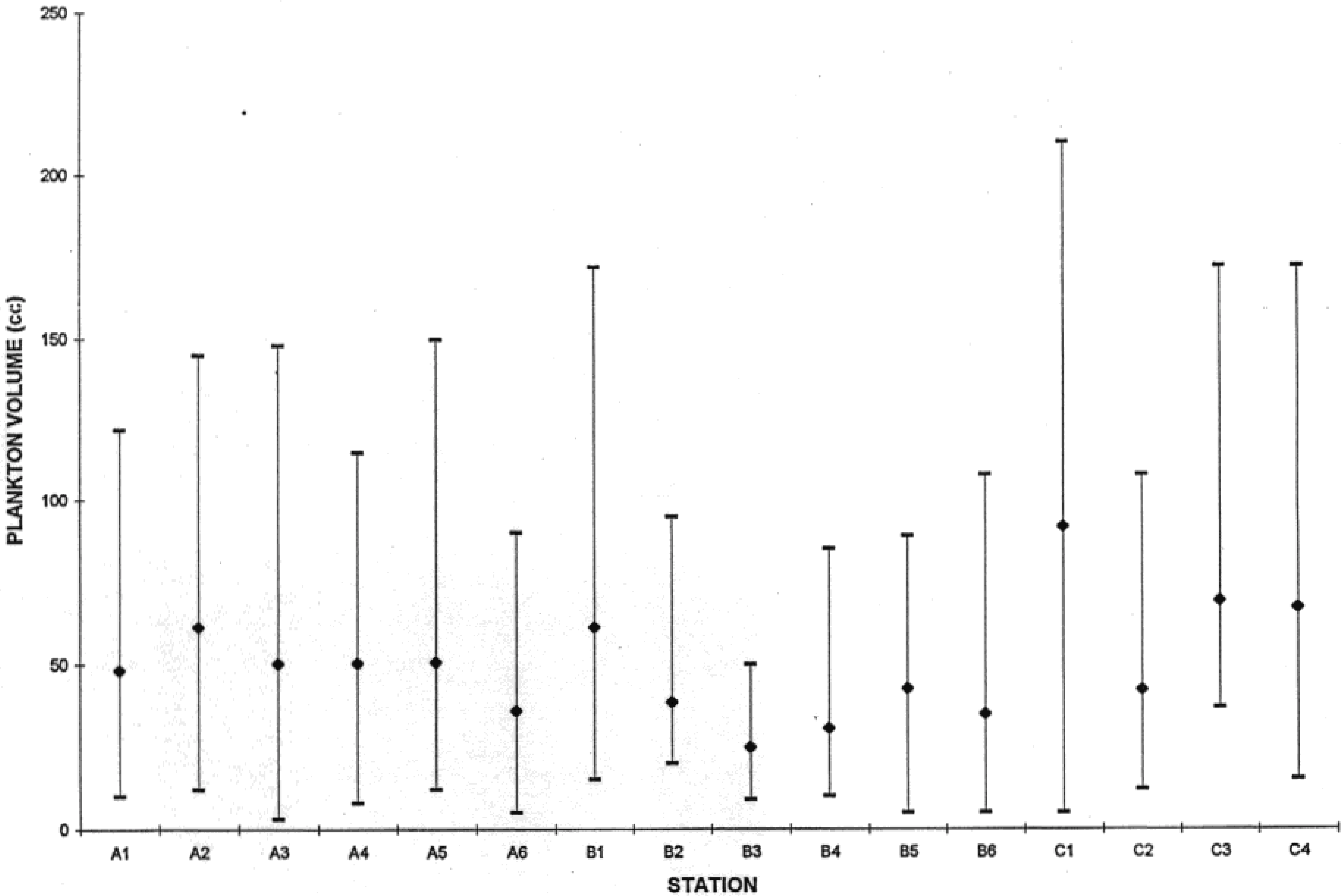


Figure 11. Total plankton volume (cc) by station in biweekly sampling with a 1.0 m plankton net during 20 minute tows in Penobscot Bay from April 4 through June 25,1997.

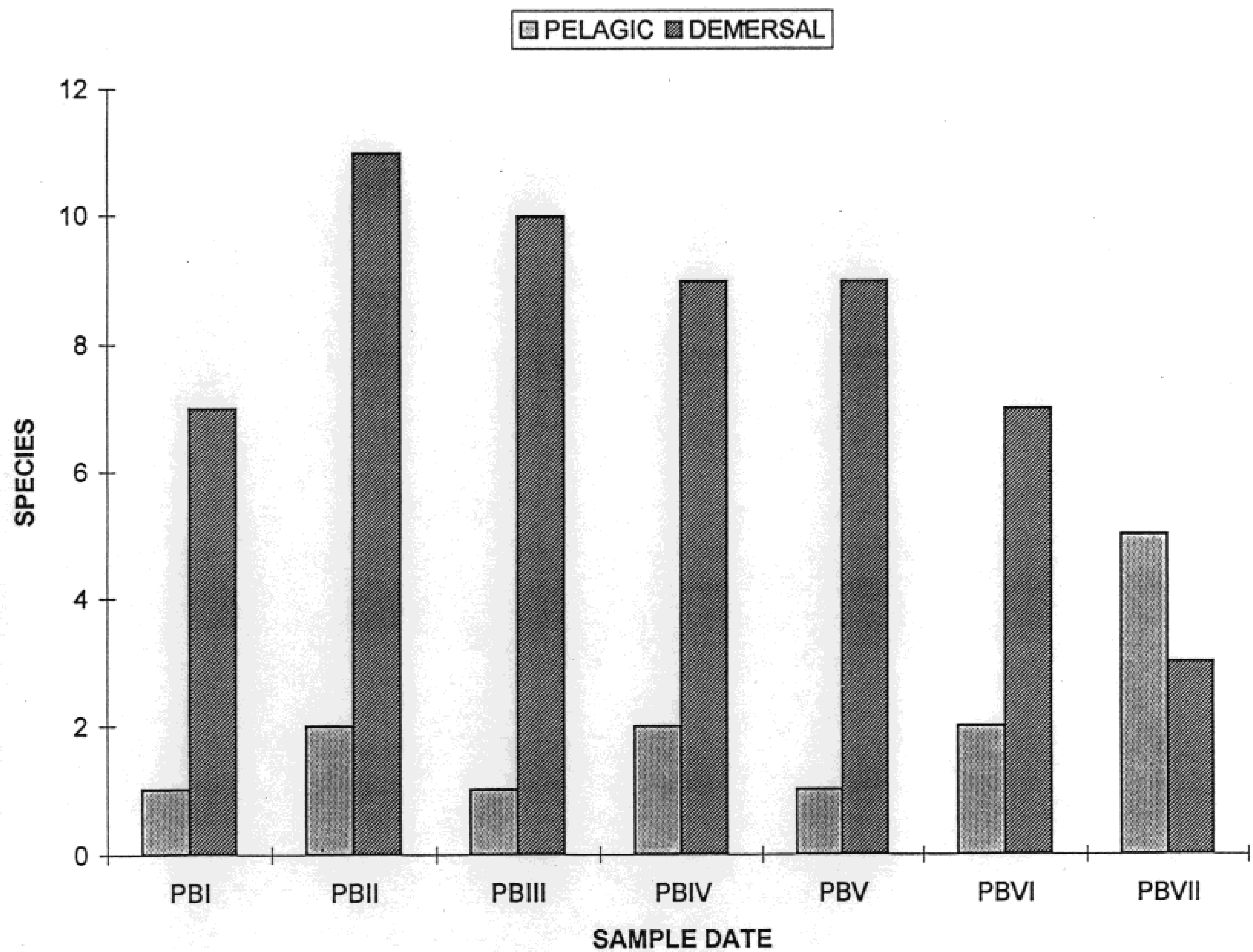


Figure 12. Number of species by by egg type and sample date in biweekly sampling with a 1.0 m plankton net during 20 minute tows in Penobscot Bay from April 4 through June 25,1997.

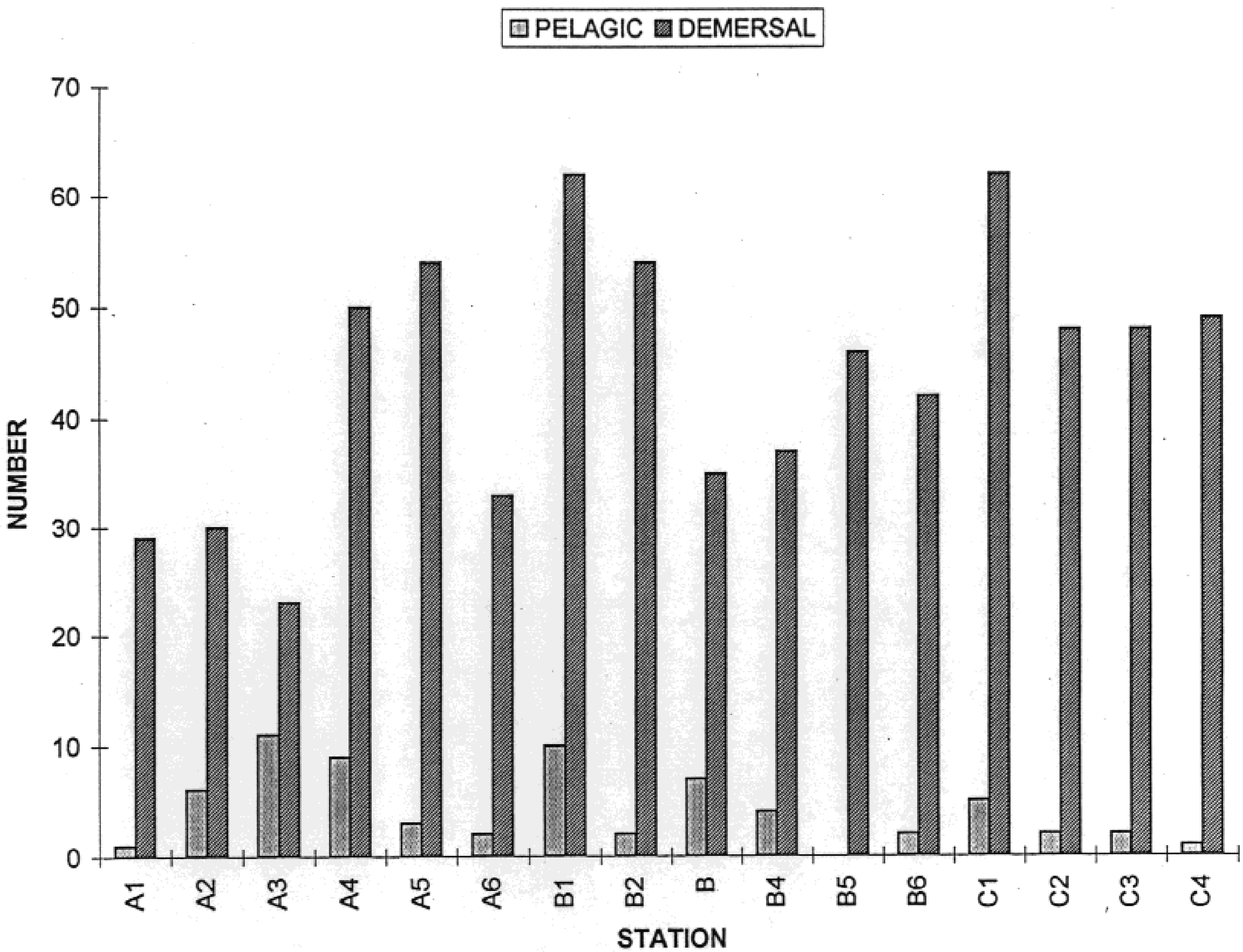


Figure 13. Number of larvae collected by egg type and station in biweekly sampling with a 1.0 m plankton net during 20 minute tows in Penobscot Bay from April 4 through June 25,1997.

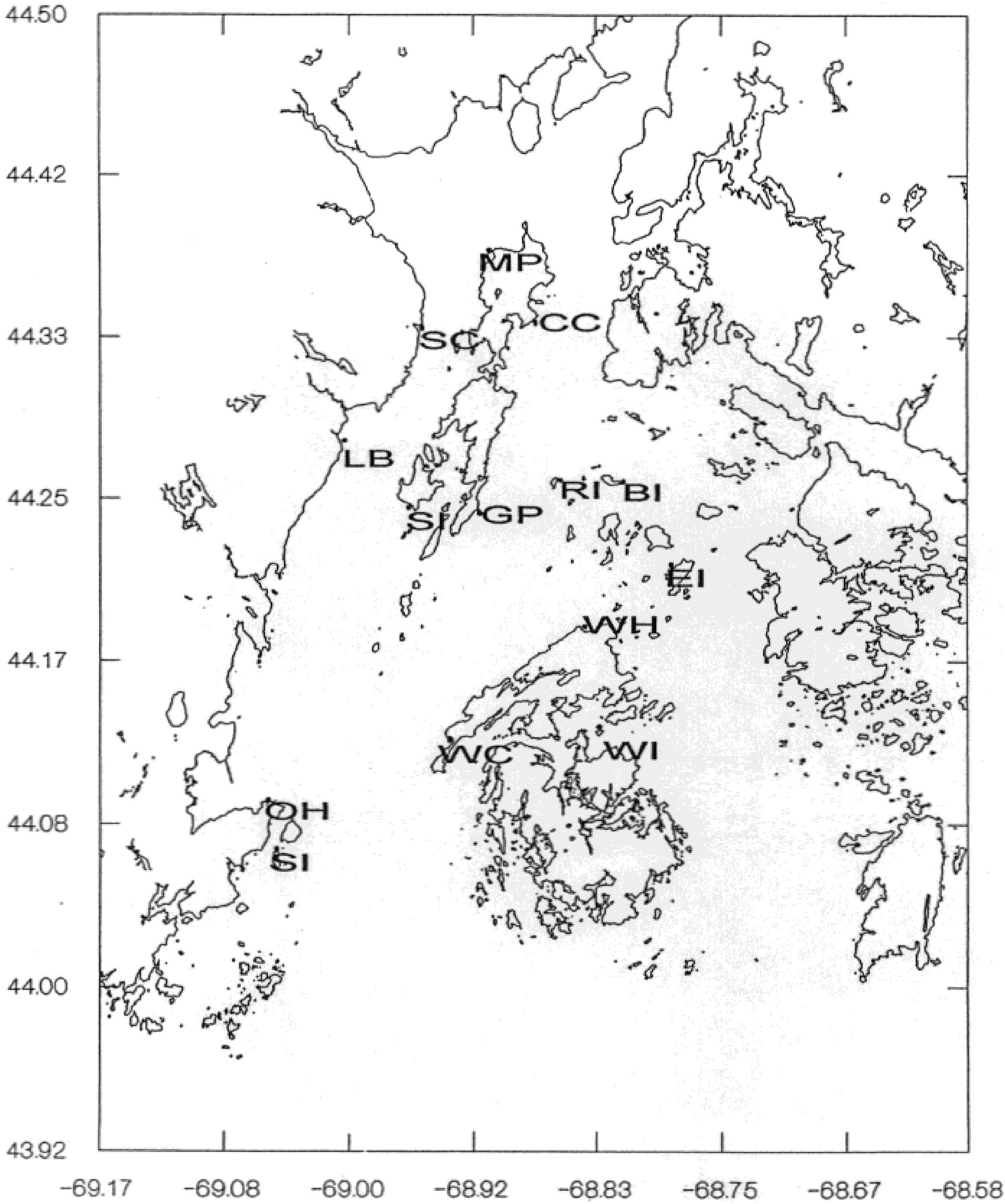


Figure 14. Map of stations sampled biweekly by 1.0 m beam trawl in Penobscot Bay from April 4 through June 25, 1997.

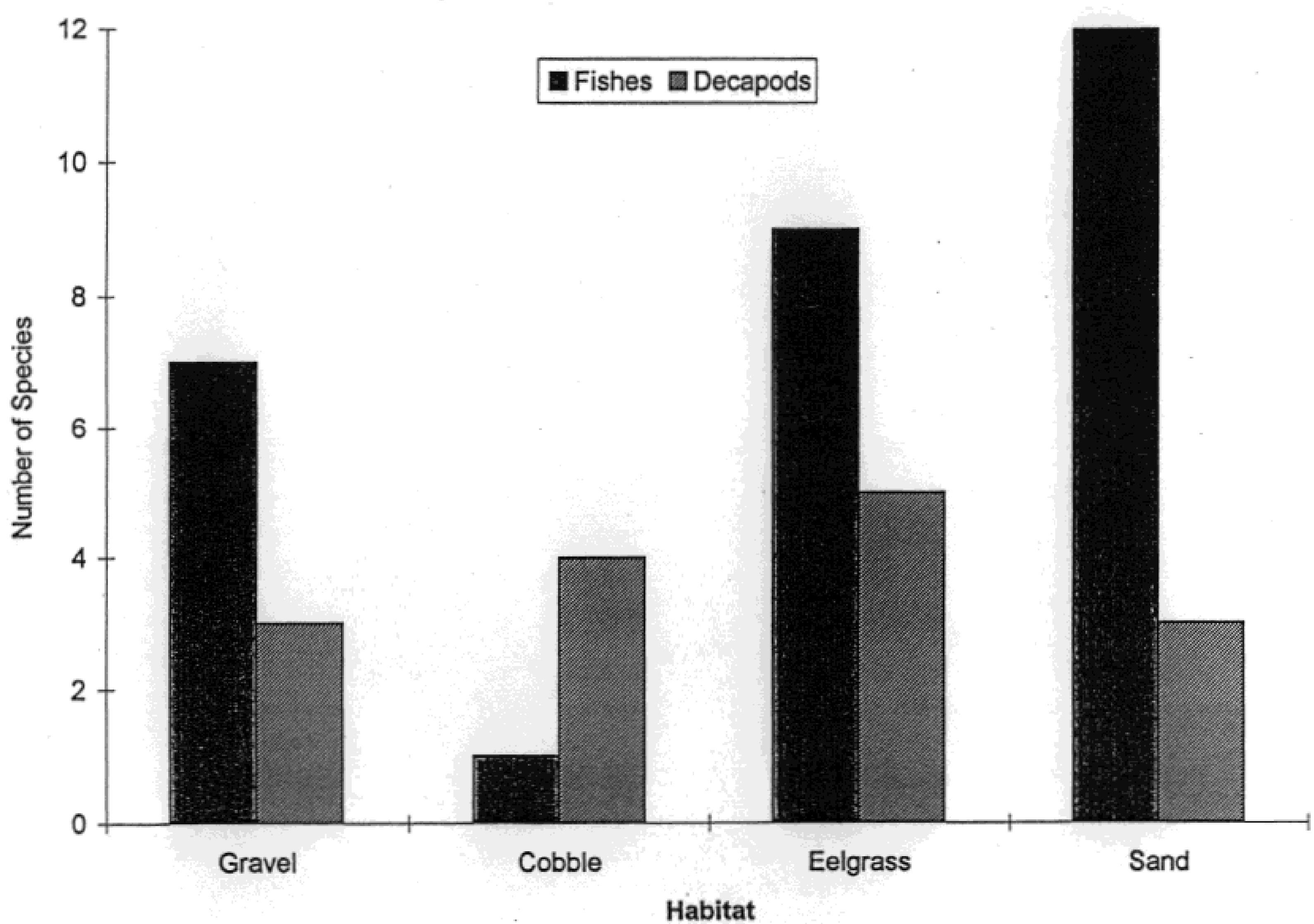


Figure 15. Number of fishes and decapod species collected by habitat with 1.0 m beam trawl in Penobscot Bay from August - September, 1997.

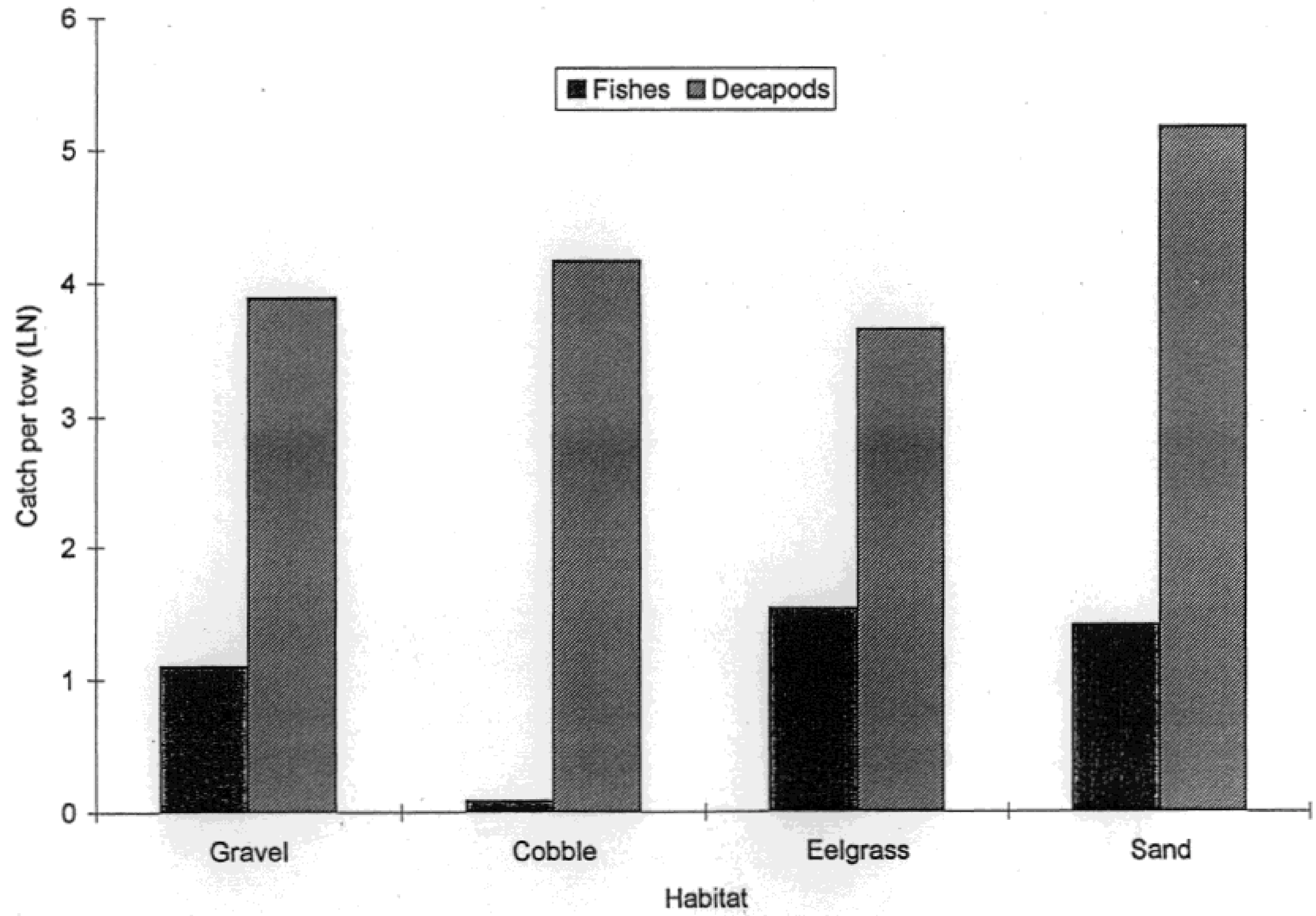


Figure 16. Abundance of fishes and decapod (natural log of number) collected by habitat with 1.0 m beam trawl in Penobscot Bay from August - September, 1997.

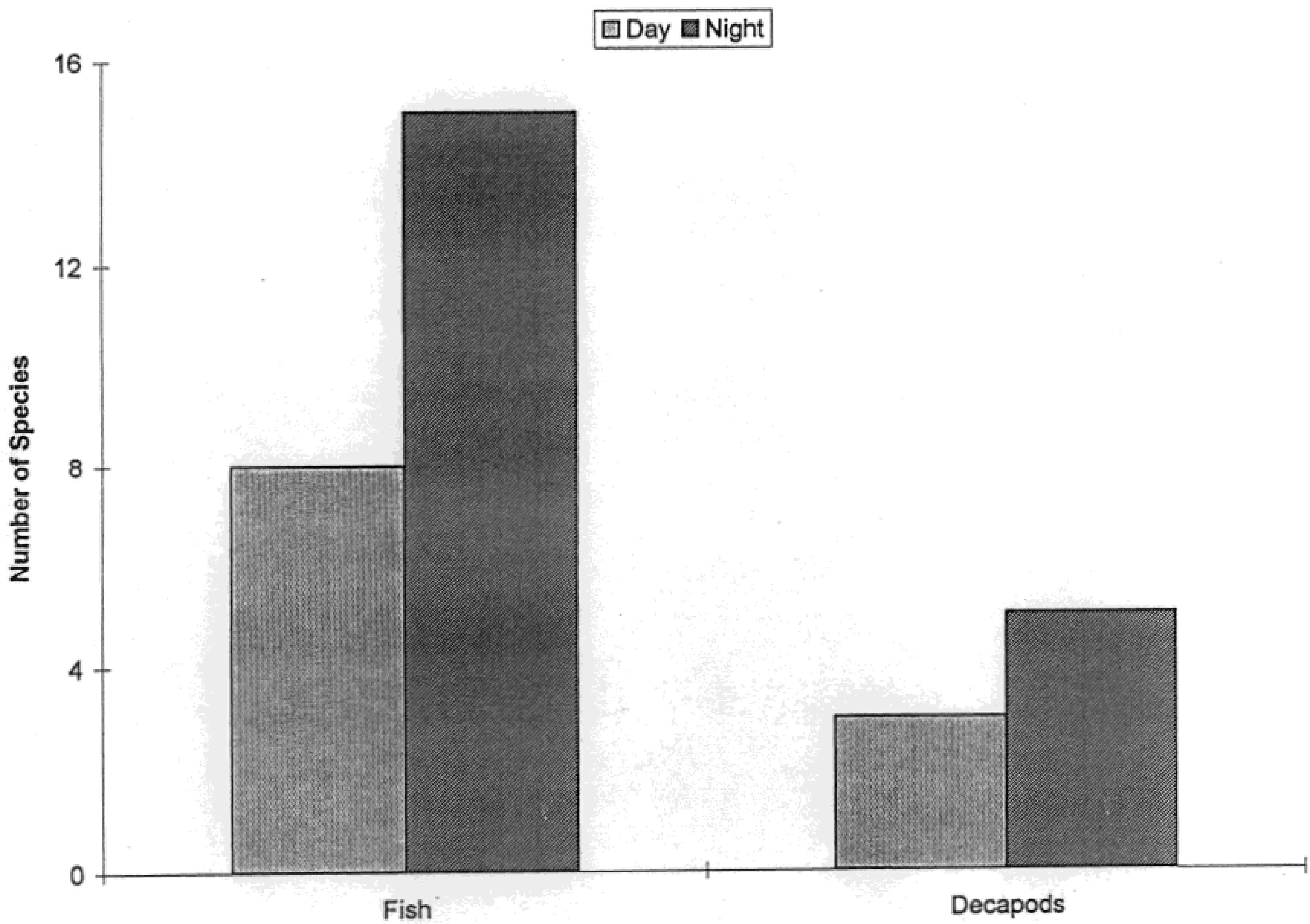


Figure 17. Number of fishes and decapod species collected by time of day with 1.0 m beam trawl in Penobscot Bay from August - September, 1997.

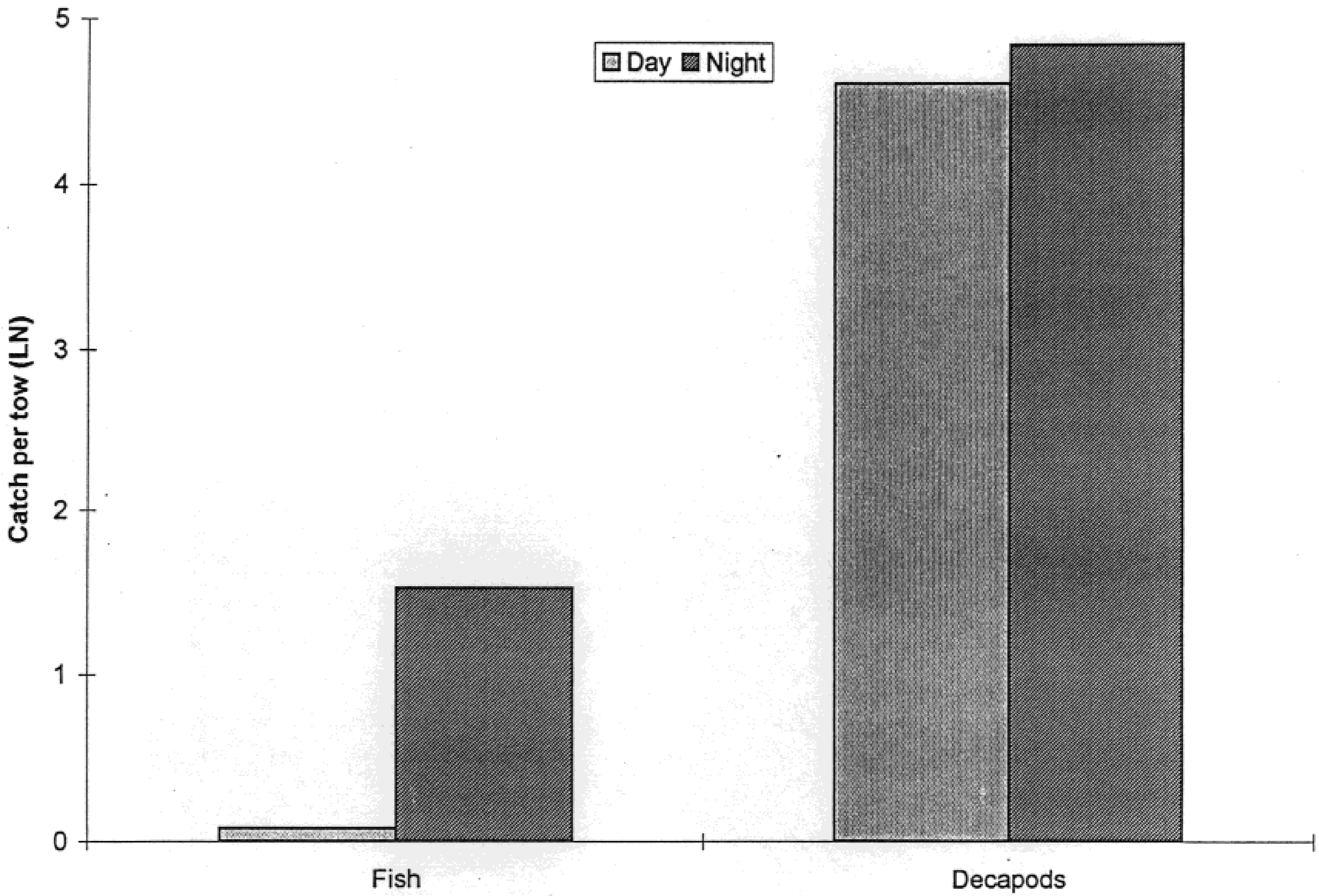


Figure 18. Abundance of fishes and decapod (natural log of number) collected by time of day with1.0 m beam trawl in Penobscot Bay from August - September, 1997.

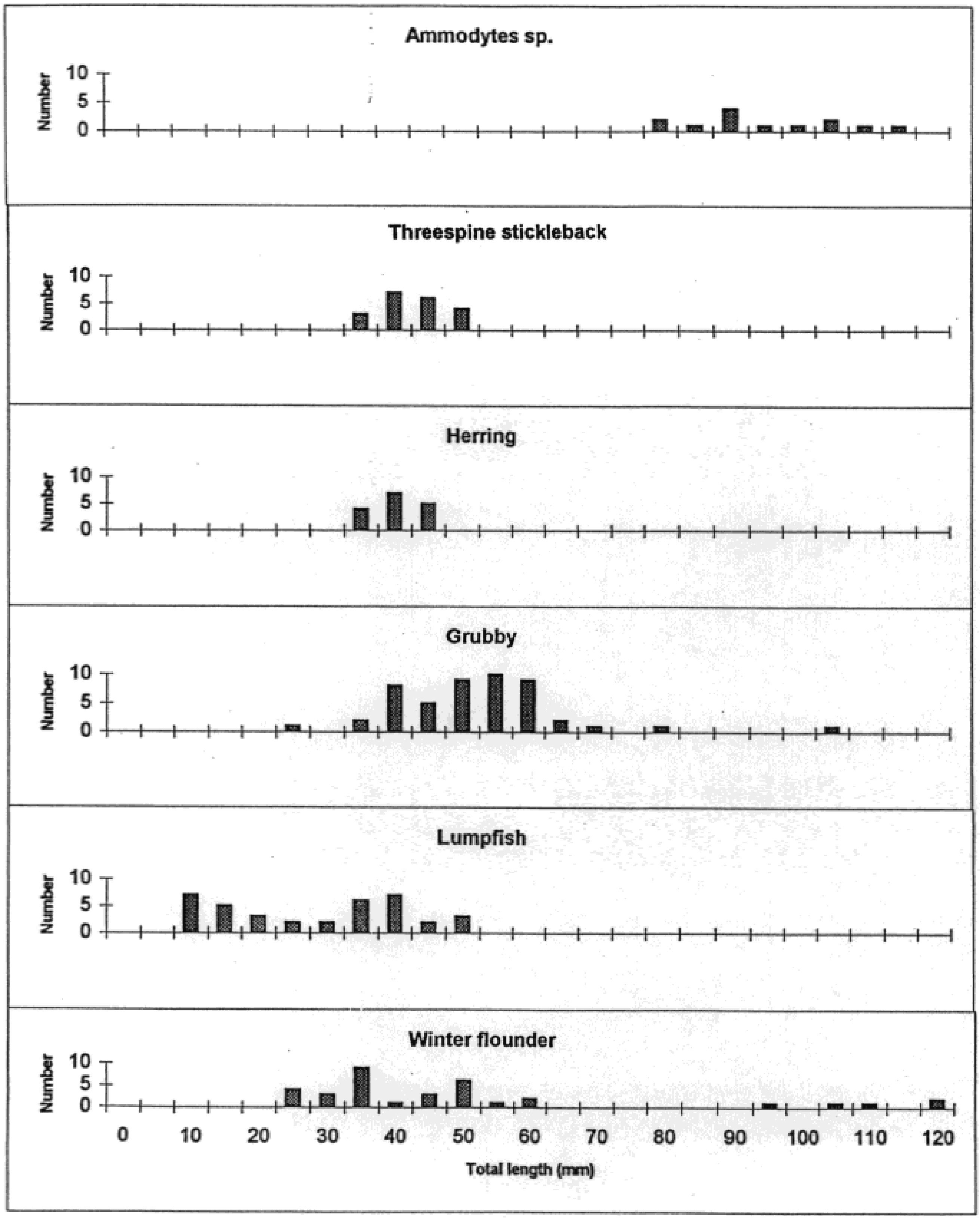


Figure 19. Total length of the more common fishes caught by 1.0 m beam trawl in Penobscot Bay August and September, 1997.

List of Appendices

Station	Plankton vol-cc	*Asp*	*Aro*	*Amo*	*Cha*	*Cma*	*Eci*	*Gmo*	*Ham*	*Hpl*	*Lat*	*Lco*	*Lin*	*Lsp*	*Mvi*	*Mto*	*Mae*	*Moc*	*Msc*	*Pgu*	*Pam*	*Ssc*	*Saq*	*Tad*	*Usu*	Unk	Total
PB A1 04-0	122	1				1			1									1									*4*
PBII A1 16-0	95	1																		1							*2*
PBIII A1 30-	32	2									1										2						*5*
PBIV A1 13-	30	2									1														1		*4*
PBV A1 28-	15										1														2		*3*
PBVI A1 09-	10									1	2										2				3		*8*
PBVII A1 24	35										1										1				2		*4*
A1 sum		6	0	0	0	1	0	0	1	1	6	0	0	0	0	0	0	1	0	1	5	0	0	0	8	0	30
PBI A2 04-	60					1												3									*4*
PBII A2 17-0	145	1								1																	*2*
PBIII A2 30-	40	6									1		1				1			2							*11*
PBIV A2 13-	42								1												3						*4*
PBV A2 29-	12																				1						*1*
PBVI A2 09-	20						1			1										1					1		*4*
PBVII A2 25	110						2				1										4	1			2		*10*
A2 sum		7	0	0	0	1	3	0	1	2	2	0	1	0	0	0	1	3	0	3	8	1	0	0	3	0	36
PB A3 04-0	40	1																		2							3
PBII A3 17-0	60																1										*1*
PBIII A3 01-	35	3								1							1										*5*
PBIV A3																											
PBV A3 29-	3									1	1																*2*
PBVI A3 10-	16									1															5		*6*
PBVII A3 25	148						1			3											3	4			6		*17*
A3 sum		4	0	0	0	0	1	0	0	6	1	0	0	0	0	0	2	0	0	2	3	4	0	0	11	0	34
PBI A4																											
PBII A4 17-0	98				1	2			1			1								2							*7*
PBIII A4 01-	47	8		1							1										1						*11*
PBIV A4 12-	15			1	1						2										2						*6*
PBV A4 29-	8										2									1							*3*
PBVI A4 10-	20									4	2				1						1				4		*12*
PBVII A4 25	115						3			1	4										3	1			8		*20*
A4 sum		8	0	2	2	2	3	0	1	5	11	1	0	0	1	0	0	0	0	3	7	1	0	0	12	0	59
PBI A5																											
PBII A5 17-0	95	10			1	4			1											2							*18*
PBIII A5 01-	20	8																			1						*9*
PBIV A5 12-	15					1					1										3						*5*
PBV A5 29-	13	1									3										2						*6*
PBVI A5 10-	12									1	1										2				2	1	*7*
PBVII A5 25	150						1				1											1			9		*12*
A5 sum		19	0	0	1	5	1	0	1	1	6	0	0	0	0	0	0	0	0	2	8	1	0	0	11	1	57

Table 1. Abundance of fishes by species by station caught by 1.0 m plankton net in Penobscot Bay from April 4through June 25, 1997. Species abbreviations as noted in Table 4.

Station	Plankton	Asp	Aro	Amo	Cha	Cma	Ecl	Gmo	Ham	Hpl	Lat	Lco	Lin	Lsp	Mvi	Mto	Mae	Moc	Msc	Pgu	Pam	Ssc	Saq	Tad	Usu	Unk	Total
PBI A6																											
PBII A6 17-0	90	15				3			2	1						1				2							*24*
PBIII A6 01-	25	2																			2						*4*
PBIV A6 12-	15																										*0*
PBV A6 29-	5	1																									*1*
PBVI A6 07-	10																								1	1	*2*
PBVII A6 25	72									1											2				1		*4*
A6 sum		18	0	0	0	3	0	0	2	2	0	0	0	0	0	1	0	0	0	2	4	0	0	0	2	1	35
PB B1 04-0	42								2											1							*3*
PBII B1 16-0	172	4				1				2								1									*8*
PBIII B1 30-	70	5							1		2			1							1						*10*
PBIV B1 13-	20								1												1						*2*
PBV B1 28-	45									2	3										2				1		*8*
PBVI B1 09-	15									3	1										4				7		*15*
PBVII B1 24	65						1			1	1										2			1	23		*29*
B1 sum		9	0	0	0	1	1	0	4	8	7	0	0	1	0	0	0	1	0	1	10	0	0	1	31	0	75
PBI B2 04-0	48					3												4		3							*10*
PBII B2 16-0	95	2							3		1						1			1							*8*
PBIII B2																											
PBIV B2 13-	20										1														1		*2*
PBV B2 29-	20														2										3	1	*6*
PBVI B2 09-	20									2	2										1				19		*24*
PBVII B2 24	30																								5	1	*6*
B2 sum		2	0	0	0	3	0	0	3	2	4	0	0	0	2	0	1	4	0	4	1	0	0	0	28	2	56
PBI B3 04-0	50	1				4												2		2							*9*
PBII B3 16-0	50	7							1		1									1							*10*
PBIII B3																											
PBIV B3 12-	15									2											2				1		*5*
PBV B3 29-	9																				3						*3*
PBVI B3 09-	11									2	1										2				2	1	*8*
PBVII B3 24	15						2			1															3	1	*7*
B3 sum		8	0	0	0	4	2	0	1	5	2	0	0	0	0	0	0	2	0	3	7	0	0	0	6	2	42
PBI B4																											
PBII B4 17-0	85	17							1		1																*19*
PBIII B4																											
PBIV B4 12-	10										2										2						*4*
PBV B4 29-	12										1				2										4		*7*
PBVI B4 10-	12								1	2																	*3*
PBVII B4 25	35						1														3		1		2	1	*8*
B4 sum		17	0	0	0	0	1	0	2	2	4	0	0	0	2	0	0	0	0	0	5	0	1	0	6	1	41

Station	Plankton	*Asp*	*Aro*	*Amo*	*Cha*	*Cma*	*Ecl*	*Gmo*	*Ham*	*Hpl*	*Lat*	*Lco*	*Lin*	*Lsp*	*Mvi*	*Mto*	*Mae*	*Moc*	*Msc*	*Pgu*	*Pam*	*Ssc*	*Saq*	*Tad*	*Usu*	Unk	Total
PBI B5																											
PBII B5 17-0	89	23	1														1			2	1						28
PBIII B5																											
PBIV B5 12-	50		1								1									1						1	4
PBV B5 29-	5										1				4						1						6
PBVI B5 10-	20										2														2		4
PBVII B5 25	50										2										1					1	4
B5 sum		23	2	0	0	0	0	0	0	0	6	0	0	0	4	0	1	0	0	3	3	0	0	0	2	2	46
PBI B6																											
PBII B6 17-0	60	9							1							2				1							13
PBIII B6 01-	15	2									2									1	9						14
PBIV B6 12-	5																				6						6
PBV B6 29-	8										1										2						3
PBVI B6 10-	15																								1	1	2
PBVII B6 25	108						1			1											3				1		6
B6 sum		11	0	0	0	0	1	0	1	1	3	0	0	0	0	2	0	0	0	2	20	0	0	0	2	1	44
PBI C1 07-0	210	3							2	1								1		1							8
PBII C1 16-0	210	1						1	1								2			1							6
PBIII C1 30-	50	4							1		1						1	1		1							9
PBIV C1 13-	38								1																		1
PBV C1 28-	25				1																				2		3
PBVI C1 09-	5																				1						1
PBVII C1 24	105						1			1	5										1			1	30		39
C1 sum		8	0	0	1	0	1	1	5	2	6	0	0	0	0	0	3	2	0	3	2	0	0	1	32	0	67
PBI C2 07-0	108					2			4								1	1		5							13
PBII C2 16-0	55	2																		2							4
PBIII C2 30-	30	2								1	1									1	1						6
PBIV C2 13-	40	3								1											4				3		11
PBV C2 28-	22										2										3						5
PBVI C2 09-	12										3				1						3						7
PBVII C2 24	30										1														3		4
C2 sum		7	0	0	0	2	0	0	4	2	7	0	0	0	1	0	1	1	0	8	11	0	0	0	6	0	50
PB1 C3 07-	172	1							1									1	2	3						1	9
PBII C3 16-0	90	1																									1
PBIII C3 30-	60	3							1		2									1	1						8
PBIV C3 13-	37						1			1	1										1				1		5
PBV C3 28-	45										1														3		4
PBVI C3 09-	40			1							2														6		9
PBVII C3 24	40									1	3													1	7		12
C3 sum		5	0	1	0	0	1	0	2	2	9	0	0	0	0	0	0	1	2	4	2	0	0	1	17	1	48

Species	Plankton	*Asp*	*Aro*	*Amo*	*Cha*	*Cma*	*Ecl*	*Gmo*	*Ham*	*Hpl*	*Lat*	*Lco*	*Lin*	*Lsp*	*Mvi*	*Mto*	*Mae*	*Moc*	*Msc*	*Pgu*	*Pam*	*Ssc*	*Saq*	*Tad*	*Usu*	Unk	Total
PBI C4 07-0	172					1														2							*3*
PBII C4 16-0	110	1																									*1*
PBIII C4	65	3				1					1						1			1	2						*9*
PBIV C4 13-	22										1														1		*2*
PBV C4 28-	40								1	1	2										2				6		*12*
PBVI C4 09-	15										1										1				1		*3*
PBVII C4 24	45										2										1				21	5	*29*
C4 sum		4	0	0	0	2	0	0	1	1	7	0	0	0	0	0	1	0	0	3	6	0	0	0	29	5	59
		156	2	3	4	24	15	1	29	42	81	1	1	1	10	3	10	15	2	44	102	7	1	3	206	16	779

Station	Plankton vol-cc	Asp	Aro	Amo	Cha	Cma	Ecl	Gmo	Ham	Hpl	Lat	Lco	Lin	Lsp	Mvl	Mto	Mae	Moc	Msc	Pgu	Pam	Ssc	Saq	Tad	Usu	Unk	Total
PB A1 04-0	122	1				1			1									1									4
PB A2 04-0	60					1												3									4
PB A3 04-0	40	1																		2							3
PB B1 04-0	42								2											1							3
PBI B2 04-0	48					3												4		3							10
PBI B3 04-0	50	1				4												2		2							9
PBII C1 07-0	210	3							2	1								1		1							8
PBI C2 07-0	108					2			4								1	1		5							13
PB1 C3 07-	172	1							1									1	2	3						1	9
PBI C4 07-0	172					1														2							3
PB1 sum		7	0	0	0	12	0	0	10	1	0	0	0	0	0	0	1	13	2	19	0	0	0	0	0	1	66
PBII A1 16-0	95	1																		1							2
PBII A2 17-0	145	1								1																	2
PBII A3 17-0	60																1										1
PBII A4 17-0	98				1	2			1			1								2							7
PBII A5 17-0	95	10			1	4			1											2							18
PBII A6 17-0	90	15				3			2	1						1				2							24
PBII B1 16-0	172	4				1				2								1									8
PBII B2 16-0	95	2							3		1						1			1							8
PBII B3 16-0	50	7							1		1									1							10
PBII B4 17-0	85	17							1		1																19
PBII B5 17-0	89	23	1														1			2	1						28
PBII B6 17-0	60	9							1							2				1							13
PBII C1 16-0	210	1						1	1								2			1							6
PBII C2 16-0	55	2																		2							4
PBII C3 16-0	90	1																									1
PBII C4 16-0	110	1																									1
PBII sum		94	1	0	2	10	0	1	11	4	3	1	0	0	0	3	5	1	0	15	1	0	0	0	0	0	152
PBIII A1 30-	32	2									1										2						5
PBIII A2 30-	40	6									1		1				1			2							11
PBIII A3 01-	35	3								1							1										5
PBIII A4 01-	47	8		1							1										1						11
PBIII A5 01-	20	8																			1						9
PBIII A6 01-	25	2																			2						4
PBIII B1 30-	70	5							1		2			1							1						10
PBIII B6 01-	15	2									2									1	9						14
PBIII C1 30-	50	4							1		1						1	1		1							9
PBIII C2 30-	30	2								1	1									1	1						6
PBIII C3 30-	60	3							1		2									1	1						8
PBIII C4 30-	65	3				1					1						1			1	2						9
PBIII sum		48	0	1	0	1	0	0	3	2	12	0	1	1	0	0	4	1	0	7	20	0	0	0	0	0	101

Table 2. Abundance of fishes by species by sample date caught by 1.0 m plankton net in Penobscot Bay from April 4 through June 25, 1997. Species abbreviations as noted in Table 4.

Station	Plankton	*Asp*	*Aro*	*Amo*	*Cha*	*Cme*	*Ecl*	*Gmo*	*Ham*	*Hpl*	*Lat*	*Lco*	*Lin*	*Lsp*	*Mvi*	*Mto*	*Mae*	*Moc*	*Msc*	*Pgu*	*Pam*	*Ssc*	*Saq*	*Tad*	*Usu*	Unk	Total
PBIV A1 13-	30	2									1														1		*4*
PBIV A2 13-	42								1												3						*4*
PBIV A3 13-05-97																											
PBIV A4 12-	15			1	1						2										2						*6*
PBIV A5 12-	15					1					1										3						*5*
PBIV A6 12-	15																										*0*
PBIV B1 13-	20								1												1						*2*
PBIV B2 13-	20										1														1		*2*
PBIV B3 12-	15									2											2				1		*5*
PBIV B4 12-	10										2										2						*4*
PBIV B5 12-	50		1								1									1						1	*4*
PBIV B6 12-	5																				6						*6*
PBIV C1 13-	38								1																		*1*
PBIV C2 13-	40	3								1											4				3		*11*
PBIV C3 13-	37						1			1	1										1				1		*5*
PBIV C4 13-	22										1														1		*2*
PBIV sum		5	1	1	1	1	1	0	3	4	10	0	0	0	0	0	0	0	0	1	24	0	0	0	8	1	61
PBV A1 28-	15										1														2		*3*
PBV A2 29-	12																				1						*1*
PBV A3 29-	3									1	1																*2*
PBV A4 29-	8										2									1							*3*
PBV A5 29-	13	1									3										2						*6*
PBV A6 29-	5	1																									*1*
PBV B1 28-	45									2	3										2				1		*8*
PBV B2 29-	20														2										3	1	*6*
PBV B3 29-	9																				3						*3*
PBV B4 29-	12										1				2										4		*7*
PBV B5 29-	5										1				4						1						*6*
PBV B6 29-	8										1										2						*3*
PBV C1 28-	25				1																				2		*3*
PBV C2 28-	22										2										3						*5*
PBV C3 28-	45										1														3		*4*
PBV C4 28-	40								1	1	2										2				6		*12*
PBV sum		2	0	0	1	0	0	0	1	4	18	0	0	0	8	0	0	0	0	1	16	0	0	0	21	1	73
PBVI A1 09-	10									1	2										2				3		*8*
PBVI A2 09-	20						1			1										1					1		*4*
PBVI A3 10-	16									1															5		*6*
PBVI A4 10-	20									4	2				1						1				4		*12*
PBVI A5 10-	12									1	1										2				2	1	*7*
PBVI A6 07-	10																								1	1	*2*

Station	Plankton	*Asp*	*Aro*	*Amo*	*Cha*	*Cma*	*Eci*	*Gmo*	*Ham*	*Hpl*	*Lat*	*Lco*	*Lin*	*Lsp*	*Mvi*	*Mto*	*Mae*	*Moc*	*Msc*	*Pgu*	*Pam*	*Ssc*	*Saq*	*Tad*	*Usu*	Unk	Total
PBVI B1 09-	15									3	1										4				7		*15*
PBVI B2 09-	20									2	2										1				19		*24*
PBVI B3 09-	11									2	1										2				2	1	*8*
PBVI B4 10-	12								1	2																	*3*
PBVI B5 10-	20										2														2		*4*
PBVI B6 10-	15																								1	1	*2*
PBVI C1 09-	5																				1						*1*
PBVI C2 09-	12										3				1						3						*7*
PBVI C3 09-	40			1							2														6		*9*
PBVI C4 09-	15										1										1				1		*3*
PBVI sum		0	0	1	0	0	1	0	1	17	17	0	0	0	2	0	0	0	0	1	17	0	0	0	54	4	115
PBVII A1 24	35										1										1				2		*4*
PBVII A2 25	110						2				1										4	1			2		*10*
PBVII A3 25	148						1			3											3	4			6		*17*
PBVII A4 25	115						3			1	4										3	1			8		*20*
PBVII A5 25	150						1				1											1			9		*12*
PBVII A6 25	72									1											2				1		*4*
PBVII B1 24	65						1			1	1										2			1	23		29
PBVII B2 24	30																								5	1	*6*
PBVII B3 24	15						2			1															3	1	*7*
PBVII B4 25	35						1														3		1		2	1	*8*
PBVII B5 25	50										2										1					1	*4*
PBVII B6 25	108						1			1											3				1		*6*
PBVII C1 24	105						1			1	5										1			1	30		*39*
PBVII C2 24	30										1														3		*4*
PBVII C3 24	40									1	3													1	7		*12*
PBVII C4 24	45										2										1				21	5	*29*
PBVII sum		0	0	0	0	0	13	0	0	10	21	0	0	0	0	0	0	0	0	0	24	7	1	3	123	9	211
		156	2	3	4	24	15	1	29	42	81	1	1	1	10	3	10	15	2	44	102	7	1	3	206	16	779

Depth (m)	TA1	SA1	TA2	SA2	TB1	SB1	TB2	SB2	TB3	SB3	TC1	SC1	TC2	SC2	TC3	SC3
1	2.454	30.491	2.776	30.846	2.578	30.840	2.549	30.847	2.854	29.790	2.815	31.006	2.796	31.008	2.905	30.850
2	2.408	30.622	2.644	30.848	2.479	30.906	2.530	30.793	2.648	29.905	2.799	30.941	2.783	30.962	2.902	31.115
3	2.397	30.680	2.587	30.849	2.443	30.923	2.385	30.759	2.530	30.050	2.782	30.972	2.787	31.033	2.877	31.128
4	2.399	30.727	2.521	30.866	2.433	30.903	2.303	30.822	2.442	30.152	2.758	31.009	2.782	31.263	2.861	31.103
5	2.404	30.724	2.486	30.888	2.424	30.937	2.258	30.911	2.427	30.362	2.750	30.933	2.778	31.052	2.851	31.054
6	2.407	30.780	2.465	30.894	2.415	30.877	2.256	30.940	2.232	30.874	2.735	30.994	2.775	31.050	2.837	31.198
7	2.446	30.828	2.463	30.901	2.404	31.005	2.277	31.003	2.198	31.001	2.733	30.960	2.756	31.076	2.829	31.124
8	2.529	30.946	2.464	30.891	2.414	30.992	2.279	30.961	2.185	31.013	2.722	30.983	2.724	31.129	2.827	31.138
9	2.372	31.020	2.468	30.896	2.418	31.006	2.265	30.941	2.177	31.053	2.706	30.988	2.711	31.165	2.825	30.978
10	2.332	31.031	2.468	30.898	2.426	31.017	2.259	30.958	2.179	31.058	2.679	31.005	2.693	31.194	2.825	31.111
11	2.299	31.050	2.469	30.890	2.459	31.005	2.255	30.975	2.194	31.071	2.634	31.077	2.685	31.212	2.824	31.036
12	2.324	31.058	2.466	30.890	2.457	31.001	2.251	31.009	2.196	31.090	2.622	31.099	2.679	31.220	2.824	31.147
13	2.354	31.049	2.471	30.898	2.444	31.092	2.234	31.043	2.177	31.131	2.645	31.122	2.673	31.243	2.825	30.987
14	2.363	31.069	2.470	30.890	2.400	31.201	2.235	31.046	2.168	31.152	2.650	31.129	2.669	31.258	2.823	31.065
15	2.355	31.066	2.436	30.921	2.386	31.159	2.242	31.070	2.186	31.189	2.662	31.147	2.665	31.280	2.822	31.063
16	2.353	31.072	2.394	30.943	2.385	31.165	2.230	31.071	2.198	31.212	2.685	31.194	2.643	31.297	2.821	31.223
17	2.347	31.089	2.354	30.975	2.379	31.162	2.253	31.086	2.190	31.163	2.716	31.257	2.626	31.292	2.816	31.002
18	2.346	31.081	2.337	31.004	2.380	31.139	2.292	31.091	2.197	31.242	2.741	31.300	2.608	31.304	2.812	30.892
19	2.343	31.079	[illegible]	31.007	2.326	31.177	2.297	31.121	2.199	31.238	2.736	31.361	2.596	31.299	2.816	31.196
20	2.333	31.082	2.321	31.007	2.270	31.252	2.315	31.191	2.209	31.239	2.763	[illegible]	2.584	31.308	2.814	31.047
21	2.321	31.094	2.326	31.024	2.260	31.301	2.317	31.196	2.208	31.242	2.766	31.439	2.569	31.317	2.813	31.151
22	2.324	31.102	2.334	31.028	2.263	31.311	2.317	31.197	2.205	31.242	2.766	31.461	2.559	31.313	2.811	31.029
23	2.328	31.107	2.313	31.043	2.264	31.331	2.317	31.206	2.204	31.252	2.765	31.466	2.558	31.311	2.810	31.100
24	2.328	31.107	2.297	31.066	2.271	31.336	2.318	31.192	2.210	31.262	2.766	31.476	2.557	31.310	2.811	31.198
25	2.329	31.107	2.302	31.067	2.275	31.406	2.313	31.185	2.210	31.270	2.767	31.479	2.554	31.311	2.810	31.037
26	2.347	31.119	2.304	31.075	2.250	31.396	2.301	31.201	2.215	31.271	2.765	31.478	2.558	31.383	2.809	31.103
27	2.381	31.136	2.306	31.079	2.246	31.440	2.279	31.194	2.213	31.258	2.764	31.479			2.809	31.085
28	2.373	31.168	2.312	31.100	2.251	31.389	2.256	31.203	2.217	31.274	2.764	31.478			2.809	31.092
29	2.374	31.180	2.321	31.111	2.254	31.455	2.243	31.233	2.219	31.277	2.764	31.482			2.809	31.004
30	2.390	31.194	2.329	31.136	2.255	31.391	2.241	31.284	2.222	31.277	2.763	31.484			2.807	31.098
31	2.419	31.229	2.330	31.144	2.254	31.403	2.260	31.343	2.270	31.282	2.763	31.486			2.808	31.166
32	2.432	31.251	2.336	31.159	2.261	31.381	2.272	31.365	2.316	31.342	2.762	31.494			2.808	31.024
33	2.436	31.267	2.344	31.164	2.267	31.355	2.293	31.369	2.345	31.404	2.763	31.491			2.808	31.148
34	2.443	31.288	2.351	31.185	2.286	31.372	2.314	31.387	2.338	31.385	2.764	31.498			2.808	31.156
35	2.453	31.311	2.359	31.195	2.291	31.375	2.342	31.404	2.373	31.418	2.768	31.509			2.809	31.019
36	2.471	31.313	2.390	31.236	2.303	31.374	2.386	31.429	2.371	31.410	2.774	31.520			2.808	31.128
37	2.506	31.374	2.405	31.257	2.332	31.366	2.414	31.444	2.372	31.417	2.782	31.543			2.809	31.049
38	2.521	31.399	2.416	31.271	2.374	31.409	2.452	31.452	2.372	31.418	2.791	31.539			2.807	31.073
39	2.531	31.396	2.424	31.281	2.392	31.435	2.457	31.468	2.389	31.437	2.795	31.558			2.808	31.002
40	2.546	31.432	2.428	31.301	2.417	31.435	2.481	31.490	2.394	31.439	2.798	31.572			2.808	31.165
41			2.445	31.317			2.517	31.505	2.400	31.439	2.798	31.572			2.807	31.027
42			2.451	31.320			2.532	31.517	2.402	31.442	2.798	31.576			2.807	31.076
43			2.454	31.330			2.531	31.525	2.417	31.457	2.798	31.582			2.806	30.993
44			2.482	31.346			2.530	31.527	2.437	31.444	2.798	31.582			2.807	31.011
45			2.499	31.400			2.526	31.527			2.807	31.589			2.806	30.995
46			2.505	31.404			2.524	31.528			2.815	31.598			2.807	30.723
47			2.505	31.407			2.521	31.529			2.849	31.603			2.807	30.924
48			2.506	31.414			2.522	31.529			2.862	31.607			2.807	30.745
49							2.523	31.527			2.861	31.619			2.807	30.830
50							2.521	31.532			2.871	31.620			2.807	30.801
51							2.522	31.532			2.880	31.633			2.807	30.715
52							2.524	31.535			2.904	31.632			2.808	30.840
53							2.532	31.540			2.908	31.649			2.809	30.628
54							2.541	31.540			2.919	31.645			2.810	30.567
55							2.543	31.541			2.917	31.652			2.811	31.494

Table 3. Salinity, S (parts per thousand) and temperature, T (°C) measurements by station and depth (m) caught during the larval survey in Penobscot Bay from April 4 - 7, 1997 (PBI).

DEPTH (	TA1	SA1	TA2	SA2	TA3	SA3	TA4	SA4	TA5	SA5	TA6	SA6	TB1	SB1	TB2	SB2	TB3	SB3	TB4
1	3.9052	27.5832	4.0903	27.3736	3.5456	28.2676	3.8721	28.4475	3.6445	27.2439	3.9876	25.8480	3.4716	29.0110	3.6528	28.0824	3.6268	27.6209	4.0555
2	3.9134	27.8180	4.0332	27.6873	3.5044	28.8276	3.3972	29.6636	3.6933	28.0438	3.5768	27.7011	3.4272	29.5654	3.5082	28.6019	3.5118	28.8745	3.6141
3	3.7649	28.0995	3.6708	29.0130	3.4308	29.3724	3.3874	29.8388	3.3923	29.6687	3.5800	28.1613	3.3525	29.8264	3.3759	29.0679	3.4177	29.5489	3.3933
4	3.4980	28.5314	3.2958	30.1626	3.3010	30.2791	3.2731	30.1937	3.2734	30.0248	3.3291	29.2063	3.2935	30.0080	3.2615	29.2641	3.2779	30.0667	3.2016
5	3.3883	28.8049	3.1812	30.5599	3.1994	30.7634	3.1418	30.5452	3.0960	30.4865	3.2128	29.7228	3.2850	30.0346	3.1560	30.1681	3.1522	30.7002	3.0266
6	3.3007	29.2630	3.1226	30.7652	3.1315	31.1141	3.0181	30.9268	2.9977	30.7760	3.1883	30.0026	3.2604	30.3270	3.0938	30.7189	3.0691	31.0692	2.8741
7	3.2567	29.6996	3.0827	30.8770	3.0980	31.2422	2.9755	31.0555	2.9199	30.9816	3.0451	30.3392	3.2417	30.4640	3.0612	31.0048	3.0419	31.3889	2.8564
8	3.2348	30.2148	3.0908	30.9482	3.0769	31.3147	2.9462	31.1234	2.8616	31.1162	2.8941	30.6818	3.2234	30.5630	3.0533	31.2557	3.0321	31.4314	2.8440
9	3.2130	30.4771	3.0637	31.0952	3.0560	31.3958	2.9337	31.1593	2.8414	31.1855	2.7649	30.9551	3.2079	30.7744	3.0578	31.3132	3.0252	31.4006	2.8294
10	3.1833	30.6975	3.0116	31.1997	3.0394	31.4066	2.9188	31.2138	2.8301	31.2349	2.7073	31.0457	3.1681	31.0771	3.0563	31.3243	3.0314	31.4590	2.8057
11	3.1232	30.9887	2.9812	31.2825	3.0286	31.4574	2.8993	31.2533	2.8313	31.3097	2.6998	31.0772	3.1339	31.2590	3.0540	31.3853	3.0428	31.4826	2.7963
12	3.0619	31.2544	2.9645	31.3313	3.0149	31.4881	2.8943	31.2917	2.8359	31.3734	2.6955	31.0906	3.1076	31.2708	3.0400	31.4287	3.0417	31.4451	2.7799
13	3.0099	31.4339	2.9612	31.3602	3.0053	31.5250	2.8888	31.3280	2.8251	31.3811	2.6977	31.1055	3.1120	31.3304	3.0374	31.4599	3.0429	31.5041	2.7707
14	3.0018	31.4801	2.9534	31.3788	3.0037	31.5281	2.8891	31.3636	2.8265	31.3903	2.6927	31.1709	3.1128	31.3138	3.0417	31.4607	3.0335	31.4935	2.7674
15	2.9988	31.5033	2.9395	31.3985	3.0115	31.5395	2.8910	31.3954	2.8252	31.4027	2.6963	31.2839	3.1095	31.3965	3.0537	31.4956	3.0276	31.4970	2.7639
16	3.0013	31.5193	2.9255	31.4132	3.0181	31.5408	2.8924	31.4115	2.8163	31.4092	2.7012	31.3755	3.1014	31.3368	3.0782	31.5060	3.0239	31.5161	2.7632
17	3.0111	31.5256	2.9161	31.4180	3.0476	31.5475	2.8958	31.4154	2.8031	31.4236	2.7086	31.4027	3.0802	31.3544	3.0770	31.5060	3.0221	31.5384	2.7651
18	3.0138	31.5308	2.8967	31.4368	3.0656	31.5534	2.8935	31.4315	2.7921	31.4372	2.7196	31.4155	3.0628	31.4418	3.0729	31.5073	3.0254	31.5278	2.7657
19	3.0142	31.5408	2.8823	31.4487	3.0721	31.5408	2.9060	31.4477	2.7973	31.4441	2.7273	31.4471	3.0675	31.4035	3.0726	31.5141	3.0279	31.5146	2.7671
20	3.0150	31.5416	2.8971	31.4842	3.0821	31.5366	2.9281	31.4684	2.8066	31.4602	2.7325	31.4505	3.0525	31.4405	3.0901	31.4999	3.0304	31.5278	2.7677
21	3.0154	31.5561	2.9231	31.4895	3.0898	31.5317	2.9658	31.4801	2.8104	31.4732	2.7344	31.4566	3.0463	31.4837	3.0983	31.5256	3.0299	31.5227	2.7732
22	3.0174	31.5636	2.9339	31.5058	3.0730	31.5428	2.9808	31.5026	2.8064	31.4803	2.7342	31.4637	3.0473	31.4848	3.1060	31.5305	3.0306	31.5155	2.7736
23	3.0083	31.5859	2.9405	31.5139	3.0586	31.5633	2.9883	31.5190	2.8050	31.4874	2.7338	31.4608	3.0477	31.4951	3.0963	31.5441	3.0308	31.5182	2.7783
24	3.0040	31.5902	2.9490	31.5173	3.0719	31.5645	2.9905	31.5213	2.8017	31.4817	2.7337	31.4618	3.0466	31.5112	3.0829	31.5581	3.0300	31.5231	2.7827
25	3.0086	31.5916	2.9523	31.5209	3.1049	31.5513	2.9933	31.5201	2.8051	31.4885	2.7315	31.4649	3.0474	31.5226	3.0810	31.5631	3.0299	31.5149	2.7937
26	3.0158	31.5938	2.9572	31.5370	3.1059	31.5533	2.9938	31.5247	2.8071	31.4883	2.7299	31.4624	3.0636	31.5540	3.0773	31.5641	3.0297	31.5226	2.8025
27	3.0220	31.5954	2.9584	31.5439	3.0998	31.5578	2.9945	31.5254	2.8065	31.4900	2.7309	31.4647	3.0662	31.5555	3.0667	31.5698	3.0297	31.5080	2.8246
28	3.0287	31.5982	2.9610	31.5466	3.0957	31.5673	2.9978	31.5239	2.8058	31.4913	2.7339	31.4668	3.0599	31.5666	3.0573	31.5812	3.0287	31.5178	2.8440
29	3.0324	31.5999	2.9655	31.5483	3.0733	31.5998	3.0014	31.5269	2.8054	31.4898	2.7365	31.4701	3.0514	31.5743	3.0546	31.5858	3.0297	31.5180	2.8602
30	3.0346	31.6028	2.9748	31.5627	3.0332	31.6083	3.0073	31.5308	2.8085	31.4928	2.7408	31.4709	3.0439	31.5776	3.0510	31.5921	3.0293	31.5160	2.8686
31	3.0352	31.6035	2.9838	31.5690	3.0214	31.6169	3.0102	31.5325	2.8207	31.4944	2.7419	31.4753	3.0415	31.5792	3.0496	31.5899	3.0273	31.5255	2.8892
32	3.0350	31.6057	2.9880	31.5724	3.0244	31.6191	3.0150	31.5387	2.8317	31.4934	2.7457	31.4749	3.0416	31.5753	3.0515	31.5845	3.0273	31.5367	2.8943
33	3.0345	31.6074			3.0245	31.6282	3.0183	31.5436	2.8492	31.5037	2.7482	31.4766	3.0397	31.5783	3.0520	31.5874	3.0259	31.5410	
34	3.0350	31.6072			3.0330	31.6260	3.0193	31.5462	2.8587	31.5056	2.7501	31.4766	3.0400	31.5851	3.0506	31.5902	3.0280	31.5508	
35	3.0331	31.6096			3.0375	31.6267	3.0192	31.5496	2.8611	31.5104	2.7522	31.4787	3.0399	31.5883	3.0544	31.5865	3.0276	31.5573	
36	3.0329	31.6085			3.0426	31.6257	3.0203	31.5492	2.8537	31.5112	2.7536	31.4804	3.0389	31.6007	3.0491	31.5896	3.0304	31.5632	
37	3.0325	31.6105			3.0448	31.6251	3.0230	31.5605	2.8527	31.5108	2.7554	31.4807	3.0397	31.6084	3.0509	31.5892	3.0333	31.5721	
38	3.0342	31.5184			3.0467	31.6240	3.0242	31.5626	2.8517	31.5101	2.7583	31.4799	3.0414	31.6109	3.0549	31.5928	3.0360	31.5788	
39	3.0352	31.5787			3.0465	31.6253	3.0295	31.5669	2.8495	31.5129	2.7598	31.4842	3.0407	31.6190	3.0548	31.5959	3.0361	31.5834	
40	3.0361	31.6206			3.0465	31.6247	3.0326	31.5731	2.8539	31.5112	2.7596	31.4881	3.0397	31.6192	3.0528	31.5963	3.0360	31.5868	
41					3.0475	31.6247			2.8575	31.5135	2.7621	31.4901	3.0398	31.6226	3.0499	31.5967	3.0377	31.5855	
42					3.0483	31.6220			2.8671	31.5127	2.7627	31.4912	3.0401	31.6170	3.0482	31.5975	3.0368	31.5876	
43					3.0482	31.6222			2.8670	31.5137	2.7676	31.4937	3.0411	31.6093	3.0472	31.5972	3.0401	31.5871	
44					3.0484	31.6223			2.8673	31.5148	2.7731	31.4954	3.0414	31.6051	3.0479	31.5967	3.0434	31.5851	
45					3.0478	31.6213			2.8688	31.5159	2.7755	31.4990	3.0414	31.5509	3.0464	31.5998	3.0491	31.5873	
46					3.0478	31.6218			2.8736	31.5149	2.7796	31.4995	3.0421	31.5448	3.0431	31.6028			
47					3.0486	31.6220			2.8748	31.5158	2.7812	31.4999	3.0475	31.3019	3.0426	31.6003			
48					3.0481	31.6195			2.8761	31.5156	2.7811	31.5014	3.0465	31.6116	3.0426	31.6019			
49					3.0495	31.6204			2.8773	31.5174	2.7829	31.5010			3.0418	31.6024			
50					3.0535	31.6155			2.8797	31.5167	2.7840	31.5026			3.0412	31.6026			
51					3.0556	31.6166			2.8803	31.5183	2.7849	31.5027			3.0413	31.6031			
52					3.0520	31.6197			2.8832	31.5203	2.7858	31.5017			3.0410	31.6040			
53					3.0706	31.5945			2.8859	31.5189	2.7855	31.5036			3.0401	31.6116			
54					3.0694	31.5901			2.8868	31.5194	2.7877	31.5042			3.0405	31.6206			
55									2.8882	31.5203	2.7887	31.5046			3.0421	31.6230			

Table 4. Salinity, S (parts per thousand) and temperature, T (°C) measurements by station and depth (m) caught during the larval survey in Penobscot Bay from April 16 - 17, 1997 (PBII).

SB4	TB5	SB5	TB6	SB6	TC2	SC2	TC3	SC3	TC4	SC4
25.9572	3.3388	28.3436	4.1465	22.4678	3.4487	29.1974	3.1432	30.6702	3.2287	30.5979
28.2285	3.3863	29.2748	4.2631	24.1995	3.3893	29.6157	3.1373	30.8551	3.2419	30.6695
28.8555	3.3801	29.4862	3.6585	27.3771	3.2978	29.9512	3.1750	30.7652	3.2303	30.8002
30.1540	3.4117	29.8218	3.0589	29.9362	3.2735	30.2945	3.1607	30.9012	3.2191	30.8126
30.5615	3.3671	30.0446	2.9352	30.5739	3.2583	30.4692	3.1635	30.9779	3.2326	30.8496
30.8064	3.2576	30.3302	2.8910	30.7159	3.2056	30.6806	3.1496	31.0331	3.2373	30.8416
30.8814	3.1199	30.4835	2.8549	30.8027	3.1429	30.9450	3.1297	31.0574	3.2323	30.9020
30.9420	3.0457	30.6219	2.8153	31.0128	3.1014	31.0803	3.1411	31.0657	3.1791	30.9314
30.9473	2.9664	30.7463	2.7981	31.0964	3.0805	31.1480	3.1025	31.1107	3.1136	30.9848
30.9842	2.9495	30.8196	2.7655	31.1559	3.0760	31.2376	3.0669	31.1384	3.0692	31.0183
31.0304	2.9209	30.9032	2.7302	31.3015	3.0728	31.3169	3.0539	31.1451	3.0712	31.0132
31.0745	2.8760	31.0001	2.7145	31.3318	3.0711	31.3584	3.0554	31.1547	3.0746	31.0345
31.1165	2.8618	31.0368	2.7057	31.3975	3.0685	31.4042	3.0494	31.1617	3.0685	31.0693
31.1550	2.8137	31.1504	2.7069	31.4215	3.0648	31.4348	3.0450	31.1816	3.0647	31.1074
31.1971	2.7971	31.2008	2.7232	31.4186	3.0616	31.4486	3.0491	31.1914	3.0783	31.1628
31.2229	2.7957	31.2776	2.7370	31.4554	3.0588	31.4546	3.0476	31.1964	3.0859	31.2078
31.2424	2.8005	31.3600	2.7421	31.5534	3.0574	31.4586	3.0519	31.2142	3.0906	31.2332
31.2423	2.8106	31.3685			3.0555	31.4562	3.0558	31.2284	3.1011	31.2639
31.2564	2.8175	31.3878			3.0559	31.4570	3.0547	31.2346	3.1228	31.3168
31.2627	2.8258	31.3999			3.0550	31.4555	3.0581	31.2510	3.1452	31.3406
31.2693	2.8336	31.4127			3.0521	31.4574	3.0587	31.2539	3.1554	31.3487
31.2873	2.8477	31.4260			3.0514	31.4576	3.0623	31.2744	3.1849	31.3592
31.2892	2.8521	31.4424			3.0491	31.4561	3.0656	31.2822	3.2067	31.3751
31.3046	2.8549	31.4400			3.0489	31.4612	3.0659	31.2849	3.2136	31.3768
31.3224	2.8608	31.4561			3.0457	31.4754	3.0673	31.2933	3.2235	31.3883
31.3646	2.8655	31.4654					3.0705	31.2992	3.2303	31.3933
31.3893	2.8700	31.4647					3.0736	31.3048	3.2354	31.4048
31.4066	2.8775	31.4647					3.0781	31.3105	3.2389	31.4234
31.4224	2.8837	31.4731					3.0793	31.3153	3.2352	31.4437
31.4271	2.8877	31.4771					3.0820	31.3276	3.2039	31.4657
31.4225	2.9086	31.4861					3.0853	31.3311	3.1818	31.4810
31.4758							3.0855	31.3374	3.1744	31.4874
							3.0866	31.3340	3.1737	31.4892
							3.0901	31.3426	3.1731	31.4911
							3.0900	31.3457	3.1745	31.4956
							3.0907	31.3507	3.1768	31.4962
							3.0900	31.3504	3.1795	31.5014
							3.0895	31.3506	3.1804	31.5061
							3.0911	31.3497	3.1823	31.5104
							3.0915	31.3521	3.1816	31.5127
							3.0924	31.3530	3.1840	31.5134
							3.0931	31.3570	3.1873	31.5172
							3.0949	31.3640	3.1918	31.5242
							3.0953	31.3680	3.1950	31.5241
							3.0981	31.3743	3.2007	31.5274
							3.1020	31.3774	3.2032	31.5272
							3.1050	31.3845	3.2051	31.5289
							3.1090	31.3927	3.2062	31.5316
							3.1102	31.3968	3.2076	31.5302
							3.1112	31.3947	3.2084	31.5321
									3.2092	31.5312
									3.2103	31.5316
									3.2109	31.5323
									3.2115	31.5367

DEPTH (	TA1	SA1	TA2	SA2	TA3	SA3	TA4	SA4	TA5	SA5	TA6	SA6	TB1	SB1	TB6	SB6	TC1	SC1	TC2
1	5.7595	25.1904	5.4713	27.1325	5.2888	27.6298	5.5724	26.2241	5.9178	24.3461	5.9966	21.1875	5.3306	27.1007	6.1119	21.5004	5.5249	25.8378	5.6204
2	5.5725	25.5539	5.0767	28.0259	5.1718	27.9659	5.4087	26.5106	5.8882	24.4657	5.8489	23.5798	4.8277	28.2913	6.0738	21.6099	5.2906	26.2002	5.5212
3	5.2945	26.4029	4.7650	28.8211	4.8814	28.6276	5.2076	27.3160	5.8172	24.6737	5.8412	24.2526	4.6337	29.1669	5.9863	21.7889	4.8510	27.2870	5.3322
4	5.0309	27.8596	4.7130	29.0484	4.6018	29.3681	4.8546	28.3978	5.6453	25.2891	5.8327	24.5766	4.5357	29.5500	5.8770	22.4533	4.6521	28.8505	5.0900
5	4.9148	28.6271	4.6589	29.4099	4.5871	29.5857	4.5768	29.1742	5.4233	25.9676	5.5999	25.1694	4.4588	29.8788	5.7100	22.9713	4.5790	29.7117	4.6762
6	4.7205	29.2365	4.6426	29.5902	4.5791	29.8183	4.4820	29.5213	5.0506	26.9098	5.0326	27.2878	4.3857	30.3694	5.1755	24.7614	4.5407	30.2515	4.5374
7	4.6189	29.6269	4.5893	29.9692	4.3826	30.2274	4.2924	29.9546	4.6901	28.4576	4.5733	28.3938	4.3305	30.5667	4.5552	26.9890	4.5040	30.6906	4.4560
8	4.5981	29.8475	4.5500	30.2355	4.1897	30.5724	4.1280	30.3845	4.4045	29.3678	4.3453	28.9217	4.2157	30.8037	3.9582	28.7987	4.5183	30.8500	4.2801
9	4.5950	30.0972	4.4786	30.5113	4.0991	30.6838	3.9216	30.8402	4.1195	30.0368	4.0504	29.4564	4.1843	30.8985	3.7712	29.6965	4.5439	30.9333	4.1693
10	4.5964	30.3136	4.2609	31.0067	4.0661	30.7537	3.8750	30.8792	3.9939	30.2906	3.8157	29.8645	4.1281	30.9855	3.6477	30.2870	4.5371	30.9739	4.1459
11	4.5733	30.5891	4.1789	31.1707	4.0267	30.7959	3.8311	31.0015	3.8950	30.4283	3.6724	30.2368	4.0984	31.0701	3.5615	30.6416	4.5502	31.0234	4.1448
12	4.5023	30.7418	4.1139	31.2919	3.9830	30.9142	3.7468	31.0980	3.7740	30.5985	3.4946	30.7188	4.0664	31.1470	3.4563	31.0716	4.5584	31.0138	4.1331
13	4.3933	30.8653	4.1426	31.3514	3.9086	31.0187	3.7008	31.1786	3.7235	30.7353	3.4258	31.0332	4.0441	31.1683	3.3686	31.3519	4.5522	31.0503	4.1292
14	4.2871	30.9917	4.1740	31.3590	3.8547	31.1216	3.6769	31.1868	3.7284	30.8166	3.4090	31.2124	4.0100	31.2311	3.3477	31.3352	4.5609	31.0300	4.1196
15	4.1614	31.2072	4.1797	31.3961	3.8431	31.1594	3.6627	31.2284	3.6450	30.9172	3.4145	31.2815	3.9937	31.2594	3.3460	31.3646	4.5743	31.0420	4.1156
16	4.1361	31.2544	4.0709	31.3920	3.8353	31.2280	3.6468	31.2176	3.6035	31.0227	3.4087	31.3115	3.9908	31.3143	3.3456	31.4435	4.6078	31.0449	4.1170
17	4.1274	31.2865	4.0414	31.4434	3.7943	31.2885	3.6369	31.2577	3.5482	31.0857	3.4035	31.2926	3.9880	31.3309			4.6535	31.0504	4.1094
18	4.0892	31.2938	4.0405	31.4480	3.7636	31.3214	3.6130	31.2723	3.5298	31.1283	3.4033	31.3284	3.9755	31.3563			4.7065	31.1513	4.0896
19	4.0470	31.3477	4.0173	31.4431	3.7556	31.3475	3.5688	31.2986	3.4731	31.1965	3.3922	31.3010	3.9788	31.3750			4.6767	31.2293	4.0723
20	3.9489	31.3753	3.9865	31.4726	3.7422	31.3251	3.5582	31.3360	3.4014	31.24e5	3.3906	31.3210	3.9824	31.3720			4.5979	31.2796	4.0558
21	3.9172	31.3889	3.9187	31.4849	3.7395	31.3383	3.5577	31.3029	3.3198	31.3067	3.3880	31.3178	3.9995	31.3890			4.5584	31.3333	4.0479
22	3.8963	31.4066	3.8455	31.4979	3.7340	31.3597	3.5562	31.3311	3.3063	31.2961	3.3902	31.3307	4.0222	31.4106			4.5995	31.3743	4.0544
23	3.8852	31.4285	3.8329	31.5364	3.6895	31.3716	3.5525	31.3381	3.2971	31.3058	3.3897	31.3229	4.0592	31.4013			4.6288	31.3866	4.0604
24	3.8323	31.4675	3.8319	31.5028	3.6161	31.4162	3.5480	31.3517	3.2962	31.3087	3.3888	31.3167	4.1056	31.4210			4.6303	31.4132	4.0644
25	3.7453	31.5326	3.8313	31.5208	3.5829	31.4531	3.5336	31.3764	3.2885	31.3180	3.3896	31.3129	4.1386	31.4516			4.6190	31.4441	4.0707
26	3.6859	31.5520	3.8235	31.5359	3.4787	31.4924	3.5202	31.3935	3.2767	31.3187	3.3865	31.3129	4.1776	31.4572			4.6281	31.4533	4.0852
27	3.6371	31.5952	3.8117	31.5438	3.4507	31.4839	3.5141	31.4143	3.2623	31.3212	3.3824	31.2948	4.1485	31.4857			4.6502	31.4597	4.0940
28	3.6278	31.5932	3.8005	31.5569	3.4442	31.5120	3.5086	31.4486	3.2609	31.3534	3.3817	31.3085	4.1094	31.4837			4.6663	31.4626	4.0937
29	3.6383	31.5974	3.7971	31.5478	3.4282	31.5193	3.5069	31.4614	3.2667	31.3490	3.3806	31.3098	4.0594	31.5369			4.6744	31.4663	4.0931
30	3.6460	31.6068	3.7917	31.5565	3.4195	31.5387	3.5093	31.4986	3.2796	31.3530	3.3785	31.3060	4.0533	31.5642			4.6616	31.4846	
31	3.6441	31.6248	3.7761	31.5618	3.4174	31.5496	3.5093	31.5074	3.2996	31.3671	3.3761	31.3092	4.1023	31.5849			4.6491	31.4942	
32	3.6431	31.6290	3.7634	31.5691	3.4177	31.5522	3.5113	31.5128	3.2966	31.3645	3.3717	31.3204	4.1312	31.6054			4.6546	31.5080	
33	3.6432	31.6313	3.7452	31.5873	3.4183	31.5822	3.5130	31.5151	3.3083	31.3849	3.3716	31.3193	4.1238	31.6171			4.6593	31.5121	
34	3.6414	31.6350	3.7329	31.5873	3.4289	31.5764	3.5121	31.5148	3.3158	31.3804	3.3680	31.3119	4.1177	31.6244			4.6593	31.5143	
35	3.6383	31.6293	3.7238	31.5966	3.4633	31.5935	3.5156	31.5157	3.3186	31.3860	3.3651	31.3165	4.1141	31.6285			4.6566	31.5181	
36	3.6383	31.6258	3.7153	31.5988	3.4781	31.5953	3.5142	31.5166	3.3058	31.3955	3.3634	31.3163	4.1117	31.6299			4.6569	31.5198	
37	3.6381	31.6211	3.7113	31.6088	3.4817	31.5963	3.5145	31.5162	3.2825	31.4067	3.3629	31.3194	4.1120	31.6316			4.6566	31.5194	
38	3.6578	31.6129	3.7043	31.6206			3.5149	31.5172	3.2775	31.4017	3.3625	31.3179	4.1106	31.6333			4.6552	31.5222	
39	3.6387	31.6182	3.6848	31.6197			3.5155	31.5192	3.2850	31.4133	3.3551	31.3324	4.1083	31.6365			4.6558	31.5240	
40			3.6672	31.6143			3.5166	31.5209	3.2913	31.4115	3.3492	31.3416	4.1038	31.6428			4.6506	31.5312	
41			3.6541	31.6255			3.5182	31.5225	3.2924	31.4158	3.3471	31.3491	4.1025	31.6467			4.6460	31.5394	
42			3.6502	31.6241			3.5194	31.5194	3.2915	31.4204	3.3457	31.3499	4.1008	31.6570			4.6145	31.5545	
43			3.6394	31.6287			3.5189	31.5220	3.2877	31.4177	3.3427	31.3548	4.1006	31.6599			4.5971	31.5653	
44			3.6316	31.6262			3.5204	31.5213	3.2821	31.4213			4.1013	31.6686			4.5913	31.5588	
45			3.5980	31.6265			3.5228	31.5254	3.2818	31.4269			4.1001	31.6734			4.5832	31.5579	
46			3.5693	31.6364			3.5231	31.5256	3.2872	31.4323			4.0993	31.6779			4.5431	31.5682	
47			3.5620	31.6314			3.5245	31.5242	3.2892	31.4359			4.0988	31.6786			4.5074	31.5626	
48			3.5429	31.6358			3.5239	31.5239	3.2928	31.4389			4.0996	31.6789			4.4845	31.5641	
49			3.5606	31.6198			3.5242	31.5221	3.2972	31.4399			4.0987	31.6800			4.4727	31.5693	
50			3.5935	31.6241			3.5244	31.5241	3.3058	31.4407			4.0981	31.6814			4.4574	31.5785	
51			3.5948	31.6281					3.3101	31.4472			4.0977	31.6830			4.4448	31.5931	
52			3.6171	31.6241					3.3159	31.4489			4.0968	31.6850			4.4357	31.6029	
53			3.6339	31.6226					3.3179	31.4476			4.0955	31.6880			4.4342	31.6048	
54			3.6220	31.6217					3.3261	31.4477			4.0947	31.6887			4.4333	31.6029	
55			3.5968	31.6189					3.3331	31.4518			4.0945	31.6888			4.4331	31.6028	

Table 5. Salinity, S (parts per thousand) and temperature, T (°C) measurements by station and depth (m) caught during the larval survey in Penobscot Bay from April 30 - May 1, 1997 (PBIII).

SC2	TC3	SC3	TC4	SC4
26.5513	4.8283	30.4947	4.6965	30.5104
26.3203	4.8210	30.6321	4.6894	30.4926
26.4075	4.8004	30.3903	4.6664	30.5427
26.7039	4.7884	30.3895	4.6560	30.4568
27.2172	4.7935	30.4045	4.6065	30.5432
27.9596	4.7626	30.3379	4.4987	30.5730
28.6801	4.7490	30.3596	4.4892	30.5939
28.6315	4.7132	30.4006	4.4549	30.6858
28.9249	4.6673	30.4674	4.5002	30.6796
29.3102	4.5080	30.6329	4.5147	30.6912
29.6703	4.3616	30.8020	4.4796	30.7290
29.5842	4.2289	30.8959	4.4455	30.7697
29.6361	4.1912	30.8883	4.4321	30.8331
29.7142	4.1787	30.9153	4.4323	30.8643
29.6911	4.1697	30.9060	4.4485	30.9005
29.6897	4.1661	30.9034	4.4656	30.9050
29.7213	4.1596	30.9143	4.4824	30.9497
30.0307	4.1515	30.9218	4.5039	30.9844
29.9686	4.1485	30.9148	4.5242	31.0005
30.0238	4.1536	30.9140	4.5336	31.0424
30.0925	4.1485	30.9179	4.5385	31.0597
30.1086	4.1440	30.9261	4.5513	31.1119
30.1192	4.1375	30.9291	4.5620	31.1332
30.0277	4.1369	30.9367	4.5789	31.1555
29.9544	4.1349	30.9299	4.5859	31.1706
30.0095	4.1337	30.9330	4.6091	31.1992
29.8516	4.1389	30.9446	4.6137	31.1878
31.0588	4.1424	30.9517	4.6286	31.2395
31.5956	4.1650	30.9639	4.6307	31.2262
	4.1657	30.9632	4.6580	31.2727
	4.1758	30.9983	4.6885	31.2926
	4.1890	30.9987	4.7353	31.3010
	4.1951	31.0374	4.7583	31.3156
	4.1986	31.0123	4.7872	31.3181
	4.2026	31.0108	4.8054	31.3229
	4.2161	31.0355	4.8186	31.3259
	4.2582	31.0348	4.8360	31.3454
	4.2963	31.0518	4.8409	31.3485
	4.3186	31.0900	4.8253	31.3764
	4.3872	31.1010	4.8210	31.3713
	4.4300	31.1195	4.8080	31.3741
	4.4435	31.1409	4.8047	31.3777
	4.4610	31.1347	4.7906	31.3856
	4.4837	31.1953	4.7908	31.3863
	4.5142	31.1518	4.7919	31.3833
	4.5878	31.2213	4.7934	31.3801
	4.6368	31.2747	4.7935	31.3360
	4.6405	31.2748	4.7945	31.2522
	4.6286	31.2191	4.7881	31.3869

DEPTH (	TA1	SA1	TA2	SA2	TA3	SA3	TA4	SA4	TA5	SA5	TA6	SA6	TB1	SB1	TB2	SB2	TB3	SB3	TB4
1	6.2521	28.9125	5.7863	29.1055	6.3725	24.3995	5.5995	25.9452	6.2914	21.6772	6.4110	19.7669	6.4970	28.0823	6.2262	26.9842	6.4142	26.9993	6.4834
2	5.9289	29.3008	5.6903	29.2323	5.7264	26.5142	5.4560	27.5908	5.6205	23.7027	5.7194	23.0399	6.3697	28.1865	5.9018	28.0886	6.0537	27.6993	6.0410
3	5.7390	29.5427	5.6366	29.3175	5.2582	28.6978	5.3150	28.2493	5.2703	26.6273	5.1083	23.8438	6.1172	28.2914	5.6291	28.8586	5.4244	29.3615	5.2144
4	5.4819	30.0403	5.5023	29.5977	5.0796	29.6271	5.1500	29.0359	5.0774	28.2049	4.7897	26.6644	5.8743	28.7183	5.5422	29.3089	5.3177	29.8580	5.0440
5	5.2319	30.3418	5.3636	29.9565	5.0160	29.9180	5.0468	29.2694	4.9911	28.7991	4.7546	26.1485	5.7150	29.0583	5.4439	29.6528	5.2352	30.0679	4.8805
6	5.1095	30.4816	5.3171	30.1173	4.9718	30.1062	4.8953	29.7715	4.9377	29.1778	4.8115	28.1190	5.6013	29.2241	5.3192	29.9500	5.1656	30.3008	4.7993
7	4.9754	30.5472	5.3500	30.2914	4.9643	30.2336	4.7189	30.0801	4.9171	29.4451	4.7262	29.3942	5.5161	29.4993	5.2808	30.0460	5.0858	30.4090	4.7898
8	4.8936	30.6833	5.3826	30.3887	4.9579	30.3004	4.6321	30.2728	4.9126	29.9533	4.7186	29.7780	5.3962	29.9043	5.2376	30.2316	5.0448	30.5246	4.8532
9	4.8009	30.6746	5.3851	30.4380	4.9355	30.3410	4.6072	30.4241	4.8360	30.2458	4.6796	30.0930	5.3274	30.1499	5.1633	30.4084	4.9954	30.6366	4.8297
10	4.7424	30.7474	5.3690	30.4662	4.8939	30.4871	4.6387	30.5164	4.8076	30.2868	4.6244	30.5373	5.2897	30.2788	5.1401	30.4851	4.9838	30.7063	4.7968
11	4.6850	30.8581	5.3388	30.5431	4.8964	30.5171	4.6756	30.5969	4.7801	30.4008	4.4832	30.7507	5.2739	30.3773	5.1251	30.5620	5.0042	30.7872	4.7056
12	4.6642	30.9054	5.2545	30.6356	4.8381	30.6291	4.6988	30.6741	4.7776	30.4750	4.3988	30.8745	5.2628	30.4493	5.1265	30.6138	5.0100	30.8492	4.6556
13	4.6884	30.8905	5.2018	30.6665	4.7659	30.6998	4.6944	30.7689	4.7563	30.5457	4.3839	30.9595	5.2589	30.5422	5.1293	30.6215	5.0159	30.9126	4.5505
14	4.7020	30.9392	5.1970	30.7453	4.7124	30.7834	4.6964	30.8371	4.6594	30.6535	4.3213	31.0970	5.1910	30.5899	5.1148	30.7080	5.0476	30.9682	4.5023
15	4.7354	30.9454	5.2172	30.7741	4.6803	30.8548	4.6757	30.8846	4.6059	30.6556	4.2543	31.0471	5.1946	30.6226	5.0871	30.7592	5.0483	30.9823	4.4771
16	4.7355	30.9685	5.1915	30.7971	4.6571	30.8597	4.6397	30.9327	4.5711	30.7124	4.1917	31.0514	5.1673	30.6668	5.0574	30.7598	5.0465	31.0267	4.4781
17	4.7234	30.9899	5.1552	30.8461	4.6304	30.9254	4.6166	30.9684	4.4565	30.8687	4.1330	31.0410	5.0491	30.7505	5.0401	30.8465	5.0381	31.0107	4.4897
18	4.6177	31.0732	5.1270	30.8399	4.6622	30.9400	4.5884	30.9859	4.3992	30.9459	4.0720	31.0068	4.9996	30.8224	5.0238	30.8579	5.0328	31.0272	4.4977
19	4.5243	31.1370	5.1184	30.8809	4.7602	30.9879	4.5684	31.0129	4.3798	31.0133	4.0172	31.0444	4.9835	30.8849	4.9828	30.8642	5.0111	31.0738	4.4970
20	4.4305	31.1621	5.0068	30.9804	4.7743	31.0313	4.5476	31.0149	4.3591	31.0101	3.9241	31.1239	4.9051	30.9484	4.9353	30.9364	4.9606	31.1071	4.5016
21	4.3996	31.1898	4.7377	30.9046	4.8390	31.0558	4.5305	31.0223	4.3419	30.9793	3.8921	31.1066	4.8752	30.9851	4.8997	30.9803	4.9385	31.1284	4.5165
22	4.3728	31.1786	4.6312	31.0139	4.8431	31.0927	4.5118	31.0442	4.3226	31.0338	3.8804	31.0701	4.8456	31.0414	4.8948	30.9597	4.9257	31.1307	4.5232
23	4.3511	31.1979	4.6140	31.0714	4.8097	31.1068	4.4782	31.0751	4.2928	31.0516	3.8302	31.0836	4.8503	31.0565	4.8905	31.0018	4.9240	31.1414	4.5295
24	4.3349	31.1966	4.5565	31.0841	4.7456	31.1359	4.4497	31.0919	4.2231	31.0462	3.7922	31.0747	4.8442	31.0618	4.8935	31.0168	4.9191	31.1239	4.5333
25	4.3248	31.1934	4.5417	31.1045	4.6584	31.1631	4.4080	31.1322	4.1905	31.0696	3.7721	31.1253	4.8414	31.0802	4.8902	31.0061	4.8553	31.1654	4.5354
26	4.3104	31.2269	4.5218	31.0905	4.6507	31.1663	4.3688	31.1710	4.1450	31.0935	3.7464	31.1570	4.8328	31.0880	4.8857	31.0350	4.8026	31.1968	4.5450
27	4.2925	31.2151	4.5044	31.1143	4.6275	31.1931	4.3494	31.2032	4.1128	31.0896	3.7266	31.1836	4.8315	31.0922	4.8675	31.0898	4.8213	31.2261	4.5481
28	4.2701	31.2263	4.4766	31.1355	4.6422	31.2161	4.3525	31.1943	4.1076	31.0838	3.6998	31.1814	4.8395	31.0945	4.8270	31.1579	4.8245	31.2281	4.5589
29	4.2474	31.2510	4.4676	31.1688	4.6434	31.2325	4.3496	31.1932	4.1005	31.1025	3.6878	31.1278	4.8377	31.1110	4.8132	31.1693	4.8275	31.2390	4.5676
30	4.2323	31.2459	4.4600	31.2047	4.6362	31.2418	4.3280	31.2097	4.0977	31.0995	3.6842	31.1140	4.8483	31.1242	4.8173	31.1809	4.8248	31.2307	4.5621
31	4.2256	31.2541	4.4528	31.2208	4.6091	31.2622	4.3160	31.2293	4.1146	31.0999	3.6813	31.1298	4.8612	31.1362	4.8142	31.2015	4.8246	31.2406	4.5426
32	4.2221	31.2555	4.4529	31.2305	4.5853	31.2656	4.3004	31.2337	4.1369	31.1201	3.6797	31.1523	4.8575	31.1415	4.8062	31.2141	4.8181	31.2444	4.5454
33	4.2202	31.2574	4.4528	31.2414	4.5706	31.2716	4.2980	31.2392	4.1199	31.1301	3.6798	31.1314	4.8495	31.1571	4.7989	31.1925	4.7848	31.2730	
34	4.2131	31.2684	4.4477	31.2585	4.5491	31.2697	4.2959	31.2436	4.0920	31.1595	3.6800	31.1212	4.8439	31.1671	4.7884	31.2170	4.7678	31.3013	
35	4.2047	31.2850	4.4308	31.2968	4.5331	31.2751	4.2932	31.2612	4.0743	31.1664	3.6803	31.1199	4.8439	31.1729	4.7599	31.2193	4.7587	31.2909	
36	4.1917	31.2820	4.4202	31.3116	4.5245	31.2741	4.2933	31.2512	4.0600	31.1662	3.6795	31.1171	4.8453	31.1708	4.7633	31.2381	4.7516	31.2977	
37	4.1804	31.2804	4.3935	31.3180	4.5113	31.2770	4.2926	31.2492	4.0585	31.1686	3.6792	31.1135	4.8436	31.1733	4.7285	31.2677	4.7452	31.3000	
38	4.1782	31.2753	4.3835	31.3366	4.5043	31.2800	4.2933	31.2519	4.0562	31.1668	3.6787	31.1075	4.8349	31.1776	4.6896	31.2767	4.7401	31.2994	
39	4.1791	31.2808	4.3724	31.3298	4.5003	31.2766	4.2928	31.2549	4.0522	31.1803	3.6793	31.1173	4.8285	31.1789	4.6705	31.2810	4.7355	31.3011	
40	4.1799	31.2874	4.3724	31.3251	4.4979	31.2763	4.2951	31.2616	4.0167	31.1770	3.6785	31.1093	4.8260	31.1819	4.6866	31.2906	4.7318	31.3034	
41			4.3614	31.3321	4.4961	31.2770			3.9942	31.1859	3.6760	31.1188	4.8165	31.1827	4.7060	31.2883	4.7265	31.2977	
42			4.3563	31.3181	4.4944	31.2716			3.9644	31.1832	3.6781	31.1352	4.8105	31.1857	4.7113	31.2874	4.7218	31.3012	
43			4.3453	31.3360	4.4918	31.2726			3.9424	31.1825	3.6900	31.1413	4.7899	31.1902	4.7108	31.2879	4.7115	31.3040	
44			4.3428	31.3302	4.4920	31.2723			3.9424	31.1850	3.6929	31.1463	4.7631	31.2016	4.7067	31.3079	4.6993	31.3122	
45			4.3423	31.3250	4.4889	31.2718			3.9245	31.1938			4.7417	31.2240	4.7129	31.2893	4.6817	31.3292	
46			4.3419	31.3293	4.4766	31.2740			3.9169	31.1852			4.7337	31.2520	4.7153	31.2946	4.6763	31.3518	
47			4.3309	31.3200	4.4354	31.2948			3.9038	31.1938					4.7179	31.3016			
48			4.3307	31.3254	4.4042	31.3158			3.8927	31.1952					4.7053	31.3133			
49			4.3327	31.3254	4.3847	31.3270			3.8789	31.1963					4.6959	31.3175			
50			4.3170	31.3184	4.3740	31.3338			3.8553	31.1947					4.6835	31.3241			
51			4.3157	31.3227	4.3619	31.3334			3.8367	31.2033					4.6777	31.3339			
52			4.3047	31.3126					3.8357	31.2026					4.6683	31.3267			
53			4.2947	31.3157					3.8358	31.2004					4.6625	31.3375			
54			4.2908	31.3225											4.6575	31.3346			
55			4.2830	31.3247											4.6541	31.3342			

Table 6. Salinity, S (parts per thousand) and temperature, T (°C) measurements by station and depth (m) caught during the larval survey in Penobscot Bay from May 12 - 13, 1997 (PBIV).

SB4	TB5	SB5	TB6	SB6	TC1	SC1	TC2	SC2	TC3	SC3	TC4	SC4
27.4829	5.8414	22.8388	6.1035	18.5379	5.9049	29.5051	7.1015	26.5136	6.0243	27.8223	6.7127	27.7243
27.2093	5.2348	25.6059	5.6786	20.9185	5.7329	29.9568	6.7785	26.6640	5.8006	28.6449	6.4414	28.5709
29.9381	4.8843	28.2876	5.0828	24.5700	5.4392	30.6075	6.2357	27.7562	5.5625	29.2711	6.2845	28.6316
29.9078	4.8544	28.9099	4.8339	27.8356	5.3809	30.6640	5.8323	29.2396	5.3821	29.7931	6.2338	28.5041
30.0164	4.8257	29.1987	4.7316	29.0007	5.3686	30.7578	5.3622	30.1787	5.2748	30.1428	6.0684	29.1807
30.6877	4.8006	29.3203	4.6417	29.6266	5.3555	30.7386	5.1733	30.5793	5.1276	30.4472	5.5481	30.1128
30.2532	4.7643	29.3738	4.5080	29.9951	5.3497	30.7913	5.1188	30.7175	5.0932	30.5004	5.2967	30.7696
30.6695	4.6691	29.7050	4.3600	30.4996	5.3161	30.8130	5.0951	30.8590	5.0706	30.5199	5.2450	30.6678
30.6913	4.5233	30.2218	4.2643	30.6778	5.3080	30.8373	5.0870	30.9471	5.0698	30.5905	5.2223	30.7169
30.7058	4.3916	30.4800	4.2163	30.8027	5.2788	30.8755	5.0882	31.0123	5.0544	30.5471	5.1544	30.9112
30.9975	4.3028	30.6214	4.1135	30.9424	5.2270	31.0004	5.0828	31.0585	5.0377	30.5523	5.1355	30.8795
31.0287	4.2664	30.8079	4.0609	30.9058	5.1971	31.0721	5.0648	31.1051	5.0242	30.6086	5.1176	30.8424
31.1502	4.2597	30.8666	4.0412	30.9090	5.1830	31.0948	5.0526	31.1224	5.0134	30.6495	5.0890	30.9560
31.1296	4.2907	30.8484	4.0153	30.9442	5.1823	31.1063	5.0407	31.1269	5.0011	30.6439	5.0780	31.0739
31.2728	4.3071	30.8767	3.9743	30.9444	5.1775	31.1010	5.0309	31.1302	4.9953	30.6809	5.0787	30.8360
31.2469	4.3233	30.8608	3.9671	30.9602	5.1757	31.0968	5.0236	31.1246	4.9894	30.6607	5.0690	30.9777
31.2885	4.3379	30.8393	3.9653	31.0298	5.1699	31.1096	5.0128	31.1303	4.9919	30.6778	5.0667	30.9212
31.2573	4.3531	30.8668			5.1549	31.1305	4.9938	31.1524	4.9848	30.6965	5.0689	31.0358
31.3022	4.3925	30.9018			5.1392	31.1562	4.9791	31.1636	4.9700	30.7067	5.0056	31.0937
31.2844	4.4325	30.9514			5.1372	31.1677	4.9700	31.1754	4.9658	30.7241	5.0856	30.8968
31.2999	4.4423	31.0346			5.1212	31.1948	4.9620	31.1811	4.9647	30.7370	5.0948	31.0145
31.2882	4.4448	31.0957			5.1125	31.2079	4.9566	31.1890	4.9673	30.7442	5.0986	31.0958
31.2797	4.4446	31.1184			5.1030	31.2263			4.9702	30.7658	5.0978	30.9776
31.3069	4.4465	31.1397			5.1053	31.2316			4.9722	30.7831	5.1017	31.0148
31.2845	4.4477	31.1555			5.0995	31.2474			4.9715	30.7964	5.1070	31.0905
31.2788	4.4495	31.1605			5.1054	31.2396			4.9818	30.8095	5.1112	31.0633
31.2860	4.4514	31.1742			5.0883	31.2658			4.9921	30.8276	5.1136	31.0629
31.2977	4.4532	31.1825			5.0808	31.2729			4.9916	30.8299	5.1164	31.0923
31.3064	4.4532	31.2033			5.0671	31.2683			5.0036	30.8570	5.1158	30.9876
31.3191					5.0419	31.2724			5.0168	30.8708	5.1223	31.1488
31.3394					5.0321	31.2726			5.0183	30.8699	5.1259	31.1071
31.3256					5.0242	31.2719			5.0188	30.8701	5.1268	30.9958
					5.0120	31.2810			5.0176	30.8710	5.1366	31.0912
					5.0052	31.2699			5.0236	30.8772	5.1431	31.0913
					4.9919	31.2891			5.0368	30.8829	5.1534	31.1603
					4.9726	31.2718			5.0454	30.8892	5.1556	31.1239
					4.9422	31.2924			5.0463	30.8913	5.1559	31.0274
					4.9322	31.2919			5.0507	30.8947	5.1613	31.1237
					4.9324	31.2930			5.0583	30.9019	5.1631	31.1672
					4.9200	31.3015			5.0736	30.9143	5.1624	31.1087
					4.9163	31.2859			5.0914	30.9271	5.1633	31.1211
					4.8989	31.3070			5.1092	30.9344	5.1653	31.1291
					4.8916	31.3073			5.1337	30.9486	5.1675	31.1584
					4.8745	31.2706			5.1369	30.9571	5.1713	31.1406
					4.8606	31.2814			5.1441	30.9588	5.1766	31.1112
					4.8006	31.2993			5.1492	30.9634	5.1813	31.1189
					4.7399	31.2910			5.1511	30.9651	5.1916	31.1697
					4.6678	31.2930					5.1935	31.1285
					4.5785	31.3186					5.2035	31.1376
					4.5165	31.3447					5.2093	31.1647
					4.4842	31.2900					5.2107	31.1460
					4.4228	31.3016					5.2131	31.1506
					4.3721	31.3162					5.2137	31.1611
					4.3552	31.2855					5.2136	31.1706
					4.3369	31.3004					5.2062	31.1872

DEPTH (	TA1	SA1	TA2	SA2	TA6	SA6	TB1	SB1	TB2	SB2	TB3	SB3	TC1	SC1	TC2	SC2	TC3	SC3	TC4	SC4
1	8.4683	25.77522	8.042214	27.35583	9.0773	23.8191	7.279867	28.11463	9.9574	27.5143	8.2154	27.82473	7.866786	27.50703	8.220233	27.08147	6.237233	30.32197	6.376167	30.45693
2	7.906917	26.58125	7.924689	27.53558	8.766467	24.4868	6.960886	28.67431	8.989167	27.6818	7.879583	27.53822	7.544813	28.38659	7.7709	27.69675	6.076	30.51068	6.419067	30.61653
3	7.54	27.1185	7.490225	28.1396	8.2098	25.6606	6.780083	28.99868	7.6982	28.78473	7.159383	28.62773	7.262189	28.97704	7.239443	28.75991	6.070467	30.64035	6.4104	30.63095
4	7.2326	27.96157	7.00895	28.85908	7.9538	26.56495	6.5286	29.36098	7.1386	29.17515	6.65542	29.56116	6.92596	29.57146	6.4006	30.00291	6.00115	30.60863	6.38788	30.6891
5	7.067083	28.50235	6.814411	29.47562	7.695067	27.32073	6.417267	29.6237	7.06885	29.33603	6.51622	29.6992	6.706888	29.95506	6.40064	30.16516	5.918257	30.79421	6.303933	30.59196
6	6.967517	28.93885	6.650914	29.9838	7.005333	28.30757	6.3519	29.75488	6.8128	29.8004	6.36496	30.20026	6.434175	30.36023	6.073857	30.62737	5.8878	30.71404	6.314671	30.61
7	6.6904	29.47629	6.591075	30.11104	6.4182	28.82125	6.272333	29.94548	6.501467	30.2129	6.31614	30.18146	6.369463	30.5111	5.991329	30.77759	5.874733	30.72932	6.2941	30.60258
8	6.117129	30.46763	6.4284	30.34243	6.098333	29.3904	6.122717	30.18853	6.396767	30.50983	6.215133	30.40223	6.355343	30.59003	5.9706	30.93738	5.857971	30.74556	6.290517	30.6027
9	5.781867	30.87658	6.164888	30.46499	5.808967	29.9702	5.96122	30.36746	6.31235	30.4669	6.0987	30.53237	6.34655	30.62961	5.965817	30.9886	5.850375	30.68643	6.266475	30.63693
10	5.657771	31.03396	6.151	30.45141	5.7292	30.21153	5.83255	30.63195	6.264267	30.6503	6.00054	30.67784	6.350386	30.68389	5.945667	30.9539	5.845457	30.72161	6.252286	30.68136
11	5.61726	31.06588	6.10965	30.50681	5.55835	30.38575	5.713286	30.90727	6.099625	30.583	5.94342	30.7606	6.31055	30.7469	5.9272	31.03367	5.8387	30.6878	6.192475	30.68975
12	5.550433	31.11405	6.003329	30.6458	5.375467	30.7176	5.632025	31.00838	6.02375	30.6739	5.902883	30.78042	6.268538	30.7612	5.9084	31.01754	5.833567	30.75748	6.160343	30.67259
13	5.504025	31.15456	5.771843	30.81829	5.236133	30.9042	5.5775	31.04384	6.00625	30.78103	5.86405	30.86515	6.182857	30.79724	5.8877	31.05589	5.821271	30.69721	6.09328	30.71158
14	5.459567	31.15767	5.419438	31.00996	5.207367	30.89203	5.541429	31.08314	5.99165	30.9096	5.83465	30.90978	6.139013	30.82876	5.837317	31.03033	5.8025	30.75214	6.041783	30.72887
15	5.395038	31.31184	5.330714	31.08991	5.204033	30.9053	5.528517	31.18092	5.855767	30.7859	5.79966	30.9164	6.096975	30.84208	5.79715	30.96037	5.794738	30.73881	6.0124	30.80097
16	5.33616	31.33196	5.289886	31.1078	5.1972	30.90045	5.518857	31.15237	5.7559	30.86657	5.76864	30.97404	6.066767	30.87695	5.78175	31.01098	5.790167	30.73163	6.030067	30.79833
17	5.318467	31.21672	5.201875	31.14936	5.104133	30.9158	5.50924	31.17458	5.7344	30.9179	5.74142	31.00392	6.015467	30.91372	5.777267	31.0763	5.789883	30.751	6.036914	30.82669
18	5.313538	31.25575	5.124225	31.19244	4.860733	30.9691	5.506086	31.15393	5.756567	30.9273	5.7293	31.02408	5.961163	30.96205	5.758843	31.0179	5.7845	30.74507	6.0482	30.86867
19	5.330557	31.26346	5.075113	31.19941	4.7761	30.9694	5.49416	31.15448	5.79	30.99213	5.719183	31.04195	5.940671	30.99014	5.689157	31.10856	5.784863	30.73669	6.05935	30.88668
20	5.312043	31.25939	5.071543	31.20579	4.7488	30.99107	5.489186	31.13033	5.787667	30.9425	5.707	31.0454	5.952938	31.00005	5.6826	31.09975	5.785225	30.7568	6.05905	30.88[illegible]
21	5.3072	31.27533	5.072325	31.21119	4.739033	30.9976	5.436971	31.16963	5.787	31.02407	5.69375	31.06128	5.961614	31.0088	5.665743	31.08134	5.782955	30.73869	6.075438	30.9115
22	5.311238	31.35569	5.061722	31.21246	4.733667	30.99757	5.418813	31.19196	5.7506	31.11247	5.6726	31.08569	5.9637	30.99536	5.643786	31.13559	5.782243	30.74321	6.1087	30.92142
23	5.302767	31.32003	5.024767	31.18417	4.7468	30.9925	5.4119	31.21756	5.7304	31.0901	5.66845	31.0777	5.946538	31.01735	5.6294	31.15532	5.7824	30.73541	6.167133	30.92087
24	5.267488	31.34256	4.996514	31.1991	4.75975	31.0078	5.40122	31.2832	5.708833	31.11483	5.652767	31.10075	5.929086	31.02413	5.62555	31.1317	5.782122	30.74958	6.18754	30.94194
25	5.2377	31.3215	4.965367	31.20018	4.770667	31.02297	5.38885	31.27629	5.6327	31.15598	5.626217	31.11193	5.904525	31.0419			5.778633	30.84794	6.195229	30.94523
26	5.233671	31.35599	4.96875	31.2106	4.791533	31.04473	5.383763	31.29813	5.598133	31.17637	5.59894	31.13058	5.879488	31.0512					6.226733	30.94152
27	5.2207	31.38855	4.987578	31.2063	4.809333	31.05947	5.37655	31.31511	5.583867	31.1977	5.574883	31.16198	5.846943	31.06393					6.2602	30.95197
28	5.2107	31.32806	4.988338	31.19791	4.8137	31.05055	5.373486	31.3174	5.5747	31.2045	5.53802	31.19686	5.786	31.11609					6.272433	30.96323
29	5.20604	31.4092	4.967614	31.22007	4.810333	31.06643	5.369144	31.32526	5.566267	31.2527	5.510917	31.22498	5.738043	31.14333					6.2765	30.95675
30	5.188625	31.38564	4.887825	31.23675	4.7801	31.0849	5.362017	31.18958	5.556967	31.229	5.48716	31.23288	5.672213	31.17455					6.29022	30.96036
31	5.1786	31.3553	4.808363	31.26574	4.756233	31.08713	5.341694	31.3081	5.5463	31.21753	5.46115	31.2637	5.659033	31.19427					6.296371	30.9659
32			4.769288	31.26705	4.7436	31.10425			5.544633	31.2298	5.4454	31.28288	5.655475	31.19669					6.301771	30.96989
33			4.735971	31.27541	4.730967	31.0965			5.5394	31.2222	5.442967	31.28345	5.6514	31.1982					6.307267	30.96793
34			4.729586	31.28274	4.720533	31.09697					5.43895	31.27958	5.642171	31.19981					6.303144	30.97788
35					4.6929	31.11147					5.435783	31.27948	5.628056	31.19882					6.297633	30.97913
36					4.6749	31.14118					5.431917	31.27825	5.590543	31.22077					6.294538	30.98014
37					4.65825	31.11285					5.429225	31.28033	5.547688	31.25566					6.2811	30.9833
38					4.65345	31.1184					5.427325	31.28368	5.530113	31.2677					6.274511	30.9847
39					4.6522	31.1268					5.425425	31.2771	5.526514	31.26243					6.26805	30.992
40					4.6506	31.12017					5.42535	31.27637	5.527186	31.26614					6.2638	30.99878
41					4.644575	31.1357					5.42165	31.2722	5.524263	31.26711					6.265971	31.0019
42											5.4063	31.28298	5.52185	31.26411					6.26876	31.00158
43											5.403578	31.28297	5.515743	31.27784					6.280538	31.0152
44											5.380742	31.30026	5.4934	31.28913					6.286025	31.01763
45											5.4084	31.2476	5.482914	31.29641					6.286957	31.02079
46													5.482367	31.30007					6.28786	31.0301
47													5.476867	31.3025					6.289283	31.0323
48													5.475075	31.29851					6.283183	31.03955
49													5.470875	31.3033					6.288033	31.03883
50													5.469343	31.30136					6.283913	31.04066
51													5.469486	31.2984					6.278375	31.0432
52													5.469913	31.29996					6.272113	31.04741
53													5.470014	31.29957					6.26655	31.05053
54													5.47025	31.29934					6.261375	31.05033
55													5.468489	31.30056					6.25915	31.05119

Table 7. Salinity, S (parts per thousand) and temperature, T (°C) measurements by station and depth (m) caught during the larval survey in Penobscot Bay from May 28 - 29, 1997 (PBV).

DEPTH (	TA1	SA1	TA2	SA2	TA3	SA3	TA4	SA4	TA5	SA5	TA6	SA6	TB1	SB1	TB2	SB2	TB3	SB3	TB4
1	9.3436	29.133	9.69534	29.15164	10.46972	28.95772	11.06748	28.50345	11.37052	26.91884	11.53815	26.37175	10.54068	28.76688	10.12251	29.01963	8.9386	28.46035	0.867667
2	8.90874	29.45672	9.417111	29.28892	9.741086	29.22704	10.52212	28.99896	11.42285	27.25693	11.07213	27.361	9.489325	29.6257	9.557983	29.25927	8.26946	28.85022	2.049143
3	8.58405	29.6864	8.931714	29.61674	9.37054	29.58878	9.4219	29.52278	11.44823	27.62727	10.28563	27.96817	9.058067	29.94152	9.011433	29.53348	8.08375	29.07188	3.118143
4	8.455517	29.75635	8.4841	30.04102	9.040667	29.71465	8.513175	30.06155	11.38258	28.01318	10.23284	28.49998	8.81766	30.13554	8.79334	29.65276	7.75685	29.26633	3.959833
5	8.3414	29.82518	8.21396	30.31659	8.67946	29.7552	7.8974	30.49095	10.94153	28.35777	9.21965	28.74788	8.3731	30.39284	8.04125	30.27507	7.52745	29.4133	5.101
6	8.1577	29.81413	7.791733	30.70667	8.263457	30.17164	7.477117	30.91282	10.6058	28.7077	7.79274	29.01682	8.2151	30.45188	7.96288	30.33168	7.37438	29.77002	6.06175
7	7.88048	29.9866	7.702525	30.88069	7.98418	30.33956	7.28094	30.76452	9.62975	29.21757	7.32298	29.26588	7.88925	30.6675	7.726	30.53613	7.41042	29.9313	6.955
8	7.749014	30.20441	7.523288	30.82415	7.60832	30.1307	7.185971	31.02526	8.9321	29.70984	6.8358	29.67406	7.76096	30.75554	7.564557	30.6664	7.482383	30.14187	8.026333
9	7.538125	30.22055	7.284229	30.98334	7.562667	30.29802	7.122333	31.11542	7.844917	30.15647	6.549167	30.17285	7.688583	30.74048	7.5293	30.72754	7.50365	30.2772	9.0005
10	7.360923	30.50388	7.245975	30.96798	7.346317	30.59142	7.001683	31.26193	7.271183	30.63562	6.326567	30.49067	7.612533	30.82617	7.485083	30.70247	7.357275	30.34423	10.0085
11	6.990233	30.55083	7.2453	30.82789	7.111717	30.65498	6.87232	31.42608	7.14118	30.71354	6.11926	30.66892	7.58758	30.82434	7.486817	30.72395	7.333267	30.37837	11.06783
12	6.8662	30.72408	7.023733	31.02183	7.03335	30.87847	6.763867	31.43422	6.814467	31.14673	5.91046	30.68742	7.55896	30.75726	7.3851	30.71655	7.357417	30.41353	12.00767
13	6.6624	30.75236	6.768767	31.03878	6.83656	30.84244	6.702686	31.3578	6.63656	30.95976	5.836133	30.75978	7.508057	30.83433	7.423017	30.74123	7.35832	30.47932	13.03267
14	6.6157	30.86915	6.831538	30.92734	6.763743	30.97246	6.677733	31.3649	6.373767	31.03085	5.710383	30.88425	7.435867	30.82683	7.359967	30.74563	7.250233	30.57013	14.10171
15	6.47565	30.955	6.875775	30.92673	6.640317	31.00468	6.662571	31.21919	6.17235	30.89547	5.634933	30.87178	7.376783	30.84178	7.273967	30.8311	7.052883	30.69432	15.124
16	6.323033	30.98077	6.871625	30.91524	6.49934	30.98944	6.63525	31.032	5.996275	31.0064	5.56958	30.9646	7.327525	30.88205	7.22126	30.90264	6.88875	30.74365	15.9032
17	6.1441	31.07324	6.786183	31.01042	6.469817	31.11113	6.485257	31.10526	5.913133	30.96787	5.52694	30.86586	7.278	30.89227	7.173	30.89492	6.792117	30.69547	17.00143
18	6.029614	31.15189	6.596438	30.94465	6.366929	30.98623	6.249171	31.13549	5.794433	30.87173	5.51412	30.94144	7.25208	30.92528	7.134057	30.94186	6.691433	30.75883	18.056
19	5.917757	31.07963	6.298663	30.99009	6.35978	31.01508	6.143229	31.15087	5.708367	30.86825	5.499567	30.89708	7.244933	30.91822	7.0807	30.9806	6.640683	30.8092	18.94467
20	5.8573	31.13398	6.11034	31.08012	6.31392	30.99766	6.033586	31.19333	5.7054	30.87768	-5.4854	30.88805	7.233233	30.9727	7.060957	30.97879	6.6103	30.79627	20.038
21	5.8349	31.1179	6.013375	30.98504	6.29855	31.04825	5.97875	31.34123	5.715483	30.91698	5.4745	30.88703	7.211217	30.93847	7.0028	30.97436	6.571375	30.83828	21.07
22	5.821514	31.15483	6.00184	30.99636	6.289271	31.0525	5.966588	31.13414	5.664617	30.89568	5.460625	30.8814	7.193367	30.94377	6.97015	30.96145	6.513333	30.84535	21.93483
23	5.814	31.1437	5.99952	30.9635	6.285217	31.04308	5.966063	31.21966	5.61355	30.89797	5.4487	30.89178	7.163014	30.93993	6.93485	30.96828	6.442317	30.88198	23.07917
24	5.809957	31.1158	5.995838	31.00526	6.277483	31.0557	5.9562	31.17936	5.600267	30.92098	5.4332	30.8855	7.1405	30.98334	6.90455	30.99033	6.4129	30.90852	24.1305
25	5.80182	31.11418	5.9846	30.9268	6.258767	31.0411	5.957338	31.28755	5.59282	30.8866	5.4237	30.87782	7.09475	30.97837	6.892143	30.96776	6.359717	30.92527	24.863
26	5.798214	31.1193	5.9488	30.97091	6.22194	31.02934	5.950457	31.13106	5.580167	30.91375	5.423167	30.87777	7.029613	30.9891	6.860833	30.98307	6.336233	30.95128	25.96471
27	5.791957	31.1185	5.8424	30.99426	6.2097	31.06159	5.981088	31.16889	5.568	30.89915	5.4253	30.88188	6.87918	31.03382	6.800233	30.99697	6.322433	30.9564	27.1392
28	5.789	31.14461	5.729725	31.03649	6.21278	31.0354	5.993588	31.19875	5.542483	30.9372	5.42054	30.89128	6.86006	31.04406	6.68255	31.01668	6.3159	30.94426	27.949
29	5.784233	31.14387	5.692075	31.05993	6.2118	31.0659	6.003633	31.1858	5.505433	30.97355	5.40345	30.89093	6.745588	31.04839	6.562217	31.08037	6.3119	30.96755	28.967
30	5.782675	31.08076	5.6886	31.03233	6.254043	31.07004	6.00964	31.21455	5.463683	30.95562	5.384933	30.89833	6.652717	31.06405	6.4674	31.05205	6.30964	30.98194	30.0918
31	5.778522	31.10521	5.68402	31.04637	6.297043	31.06153			5.4279	30.92854	5.369583	30.89728	6.528933	31.07706	6.44645	31.05927	6.297733	31.00155	31.0352
32	5.777171	31.0909	5.67775	31.0439	6.2944	31.07073			5.42312	30.94942	5.34855	30.90677	6.463671	31.07331	6.446767	31.06527	6.28115	31.01642	31.9372
33	5.770563	31.11094	5.672078	31.04466	6.253033	31.11823			5.40015	30.94798	5.325867	30.91425	6.364067	31.08752	6.441371	31.05914	6.25025	31.04035	32.8394
34	5.7686	31.0829	5.6721	31.06041	6.275517	31.10115			5.381483	30.9566	5.31482	30.90496	6.315217	31.09478	6.395829	31.08537	6.19302	31.07428	33.94671
35	5.763789	31.09346	5.66605	31.04351	6.2804	31.08307			5.364817	30.96815	5.313814	30.91121	6.290143	31.12564	6.36515	31.08327	6.177067	31.11065	34.98917
36	5.760388	31.09788	5.664367	31.04026	6.27185	31.08773			5.3398	30.9427	5.31404	30.90416	6.2639	31.098	6.345975	31.09376	6.11032	31.12526	35.9152
37	5.757357	31.1157	5.662283	31.0345	6.25265	31.08765			5.3295	30.9402	5.304743	30.91337	6.234586	31.13554	6.33516	31.103	6.10085	31.13965	37.008
38	5.7475	31.13042	5.66059	31.04253	6.192367	31.10989			5.329657	30.94449	5.2925	30.91481	6.227	31.10353	6.333886	31.09533	6.079117	31.1479	38.04767
39	5.738513	31.12831	5.657867	31.04362	6.14808	31.10382			5.31888	30.95728	5.28046	30.90714	6.225486	31.12331	6.330671	31.10099	6.0564	31.15608	39.073
40	5.732825	31.13038	5.657096	31.09722	6.145814	31.11501			5.32915	30.95797	5.27668	30.93284	6.224333	31.1231	6.330313	31.09514	6.040217	31.17142	40.0164
41	5.725669	31.12242			6.110383	31.10965			5.31715	30.95155			6.208833	31.12418	6.33218	31.09194	6.029	31.16903	41.03936
42	5.722275	31.11983			6.038029	31.14101			5.298643	30.9623			6.190686	31.12371	6.329517	31.08645	6.025167	31.17253	
43	5.700448	31.14091			5.99082	31.1344			5.2903	30.95425			6.1807	31.12365	6.324663	31.0908	6.03008	31.16206	
44					5.956557	31.17817							6.168271	31.13667	6.321167	31.08512	6.015417	31.17285	
45					5.9329	31.14214							6.1506	31.12843	6.302571	31.10247	6.004814	31.1762	
46					5.925483	31.15073							6.137433	31.12628	6.264633	31.10222	6.0027	31.17327	
47					5.925414	31.1445							6.123443	31.1311	6.247738	31.11474	5.99398	31.17894	
48					5.922983	31.1478							6.102686	31.13103	6.228671	31.11193	6.00094	31.16258	
49					5.92276	31.1447							6.09288	31.13834	6.222363	31.12098	5.992786	31.17513	
50													6.071071	31.1416	6.22025	31.10605	5.990017	31.1746	
51													6.06185	31.14712			5.991414	31.16317	
52													6.0598	31.14317			5.9886	31.16785	
53													6.06155	31.13975			5.989017	31.16743	
54													6.0601	31.14345			5.983757	31.17206	
55													6.0611	31.1409			5.984733	31.16562	

Table 8. Salinity, S (parts per thousand) and temperature, T (°C) measurements by station and depth (m) caught during the larval survey in Penobscot Bay from June 9 - 10 1997 (PBVI).

SB4	TB5	SB5	TB6	SB6	TC1	SC1	TC2	SC2	TC3	SC3	TC4	SC4
28.8127	9.928733	29.34795	11.3678	28.1603	9.2613	29.49005	10.3938	28.4108	7.3321	30.50415	8.809638	3.6318
29.32163	9.596467	29.8145	11.33124	27.3749	8.93833	29.80871	10.016	28.95085	7.318275	30.7543	8.000767	30.3913
29.1864	9.155233	29.33468	11.18158	27.95424	8.482467	30.26283	9.421517	29.80498	7.270083	30.89748	7.887933	30.37977
29.47812	8.56946	29.0598	10.85695	28.16173	8.1237	30.52899	8.54706	30.40564	7.189817	31.12002	7.855125	30.6336
29.48376	8.072243	29.56263	10.22896	28.61154	7.946929	30.69709	8.142717	30.56053	7.201167	30.93845	7.9374	30.84572
29.48856	7.4452	29.90738	9.88798	28.62846	7.796857	30.74737	7.958667	30.63592	7.21242	30.94126	7.924233	30.60235
29.86234	7.007586	30.27717	8.8749	29.57958	7.703582	30.72895	7.84345	30.69447	7.22398	31.07774	7.906267	30.67672
29.94098	6.65472	30.36028	7.76516	30.52068	7.692542	30.79914	7.7553	30.79718	7.22225	30.85915	7.868529	30.6467
30.25257	6.503871	30.56189	7.24718	30.65874	7.632271	30.63724	7.6153	30.78625	7.22465	30.83805	7.79148	30.62124
30.36083	6.153833	30.82682	6.781767	31.14657	7.6422	30.64259	7.5469	30.86278	7.22482	30.88432	7.77718	30.79922
30.69775	5.975167	30.9612	6.538775	31.40708	7.6633	30.67429	7.392383	30.83442	7.23155	30.78808	7.730417	30.72425
30.87917	5.936867	30.96662	6.387733	31.47252	7.61965	30.67141	7.308133	30.82877	7.229825	30.70558	7.683367	30.66373
30.85797	5.919517	30.95118	6.231317	31.51722	7.594217	30.72318	7.236114	30.92347	7.2283	30.70323	7.645433	30.70573
30.91853	5.91055	30.95643	6.116775	31.55725	7.463586	30.78466	7.129933	30.93007	7.2179	30.78237	7.58545	30.7732
30.95194	5.900767	30.94207	5.9895	31.52358	7.32335	30.79145	7.085367	30.95372	7.204417	30.71288	7.5446	30.70095
30.76008	5.8944	30.9509	5.89095	31.44338	7.161025	30.87601	7.0574	30.96707	7.20678	30.81422	7.522525	30.71845
30.94849	5.892929	30.97863	5.89245	31.4075	7.077	30.89037	6.980967	30.91417	7.198883	30.7455	7.5043	30.70617
30.97882	5.884857	30.93323			7.050286	30.93677	6.928443	30.95749	7.1906	30.7165	7.483943	30.681
31.19433	5.882229	30.98676			7.05385	30.91166	6.9072	30.92812	7.1875	30.6978	7.47722	30.68546
31.28235	5.88124	30.96452			7.003467	30.9318	6.891257	30.92673	7.15842	30.71108	7.46765	30.67635
31.23006	5.878417	30.95048			6.951357	30.95659	6.87935	30.93487	7.16932	30.70952	7.438443	30.67343
31.10785	5.875825	30.98255			6.837071	30.972	6.868563	30.93573	7.1863	30.69663	7.4194	30.6782
31.07568	5.8699	30.98586			6.656829	30.99113	6.860383	30.97077	7.18	30.676	7.408214	30.69454
31.12648	5.86795	30.998			6.48525	31.01488	6.860533	30.95727	7.1733	30.6852	7.419114	30.70546
30.96518	5.866929	30.98527			6.285822	31.01633	6.842975	30.98194	7.175683	30.702	7.43076	30.74308
31.07791	5.862833	30.96988			6.284871	31.03147	6.797657	31.00109	7.194517	30.72558	7.44706	30.76
31.02356	5.856186	30.95261			6.324743	31.03949	6.770329	31.00814	7.224833	30.76058	7.4518	30.776
31.03475	5.848967	30.94802			6.38674	31.0353	6.76415	31.01035	7.24296	30.75438	7.45288	30.77352
31.03864	5.8441	30.9731			6.44925	31.06724	6.756129	31.02831	7.244283	30.80037	7.4522	30.78583
31.04024	5.843071	31.08363			6.50105	31.08339	6.734929	31.03107	7.244583	30.80202	7.45606	30.76946
31.02984					6.534183	31.1028	6.687871	31.07447	7.256367	30.79472	7.466817	30.80735
31.04464					6.551457	31.10337	6.6378	31.0674	7.261771	30.81411	7.47496	30.80694
31.03702					6.549714	31.09833			7.2705	30.80085	7.531857	30.83749
31.06249					6.532283	31.11362			7.2884	30.80872	7.54498	30.852
31.06413					6.5267	31.09485			7.291133	30.8106	7.555786	30.85914
31.0535					6.52494	31.10728			7.31275	30.81652	7.557133	30.86025
31.06621					6.512029	31.10243			7.357286	30.83899	7.55644	30.86468
31.07287					6.503614	31.10354			7.45475	30.85587	7.5569	30.86127
31.08642					6.476825	31.10026			7.530863	30.89244	7.55578	30.8648
31.09492					6.458317	31.08915			7.5697	30.93934	7.554338	30.8718
31.13213					6.457371	31.09834			7.581869	30.93801	7.555683	30.86835
					6.445571	31.0995					7.548025	30.87418
					6.4086	31.05974					7.549313	30.88609
					6.380143	31.09563					7.555114	30.91286
					6.37196	31.10282					7.57088	30.9433
					6.340678	31.09874					7.5783	30.9442
					6.297567	31.10127					7.593588	30.97233
					6.272229	31.09097					7.6058	30.97493
					6.254471	31.1029					7.619733	30.96982
					6.220686	31.11719					7.649383	31.01077
					6.158675	31.12054					7.663286	31.0221
					6.10056	31.14584					7.691433	31.02797
					6.024488	31.1408					7.7237	31.06273
					5.9993	31.15742					7.73394	31.06854
					6.005329	31.14474						

DEPTH (	TA1	SA1	TA2	SA2	TA3	SA3	TA4	SA4	TA5	SA5	TA6	SA6	TB1	SB1	TB2	SB2	TB4	SB4	TB5
1	13.973	27.94173	14.7957	27.18427	12.72977	29.07967	12.80173	29.1339	12.732	27.31235	12.1051	27.3777	12.0255	28.37047	11.31173	28.4369	10.3415	29.1048	9.7108
2	14.01754	28.1348	14.77761	27.42361	12.10706	29.57304	12.06933	29.52727	12.29017	27.94253	11.38957	27.76137	11.9668	28.57	11.20064	28.75794	10.41098	29.26206	9.71285
3	14.11366	28.24559	14.48839	27.87331	11.7523	29.80623	11.7251	29.86592	12.23118	28.69043	11.33742	28.09556	11.7145	28.91494	11.05788	29.23078	10.0384	29.50618	9.693143
4	14.11712	28.49063	13.60153	28.67769	11.04335	30.08913	11.16826	30.12126	11.93593	29.2612	11.24895	28.1092	11.52678	29.33768	10.7128	29.71128	9.823871	29.6823	9.66172
5	13.79479	28.90541	11.77593	29.65259	10.55512	30.31917	10.54047	30.34195	11.59998	29.57602	10.98225	28.45837	11.13827	29.97158	10.49798	30.3617	9.7254	29.85328	9.6049
6	13.5507	29.10515	11.07583	29.79644	10.42608	30.39572	10.14952	30.5009	11.23554	29.71708	10.72364	28.87792	11.15588	30.33746	10.37113	30.57185	9.60318	29.94702	9.5512
7	12.89627	29.60564	10.65905	29.93853	10.0921	30.51443	9.9844	30.59605	10.60223	29.88983	10.07772	29.52316	10.84575	30.62868	10.28217	30.75018	9.4491	30.04215	9.37725
8	11.54838	29.98027	10.34851	30.2956	9.786517	30.62827	9.78608	30.7139	9.98868	30.05224	9.708383	29.99985	10.71384	30.69126	10.20604	30.8165	9.406033	30.12037	8.953533
9	10.90186	30.35931	9.791575	30.34619	9.696533	30.67558	9.594067	30.62848	9.9092	30.16632	9.43776	30.38512	10.64988	30.74768	10.12685	30.83242	9.36876	30.20476	8.671017
10	10.19709	30.45209	9.250629	30.75969	9.617583	30.70097	9.39466	30.71158	9.477767	30.39327	8.9779	30.42488	10.48145	30.77333	10.05083	30.9151	9.34886	30.3133	8.53958
11	9.835286	30.61877	8.946943	30.64694	9.441267	30.76085	9.36158	30.78956	9.12305	30.59015	8.73794	30.56104	10.3128	30.80476	9.9822	30.90537	9.185233	30.4055	8.3249
12	9.18275	30.79987	8.7241	30.684	9.2421	30.84322	9.241667	30.79042	8.850283	30.66602	8.522683	30.63873	10.27936	30.84506	9.82545	30.98787	8.88875	30.58998	7.9691
13	8.602829	30.87027	8.272625	30.92445	8.68625	31.01625	9.1093	30.76832	8.52685	30.71728	8.3351	30.68333	10.15397	30.84462	9.62784	31.0132	8.486767	30.67063	7.657667
14	8.341225	30.89483	8.2674	30.99096	8.1448	31.00763	8.980233	30.80965	8.16082	30.72628	8.037033	30.64832	10.09578	30.84768	9.6011	31.06072	8.304383	30.68827	7.522833
15	8.0866	30.83985	8.154	30.99443	7.9966	30.86513	8.90666	30.82516	8.14258	30.801	7.696267	30.72495	9.939183	30.87122	9.320783	31.15828	7.8553	30.75585	7.363833
16	7.930371	30.95059	7.8782	30.99572	7.919417	30.85795	8.68136	30.86506	7.771017	30.80038	7.553175	30.62183	9.6582	30.89718	9.25176	31.14732	7.626125	30.87135	7.293317
17	7.74505	30.94176	7.856038	31.03349	7.861783	30.8527	8.221933	30.92433	7.58356	30.90302	7.358967	30.74547	9.38648	31.0306	9.08272	31.12368	7.525633	30.82188	7.278817
18	7.674333	30.89632	7.564314	30.93177	7.844017	30.8863	7.617983	31.05018	7.309183	30.87728	7.142183	30.7679	8.96254	31.03824	8.993967	31.18617	7.3788	30.87034	7.2586
19	7.676329	30.98727	7.438388	31.10036	7.827483	30.87975	7.29466	31.078	7.07584	30.87472	6.89944	30.78838	8.72815	31.13195	8.91854	31.20614	7.31586	30.88864	7.254367
20	7.6478	30.92815	7.18355	31.01065	7.606625	30.88845	7.1639	31.08114	6.94654	30.95052	6.9009	30.8322	8.54856	31.13502	[illegible]	31.164	7.2295	30.95102	7.24712
21	7.600614	30.98594	7.085314	30.98939	7.785933	30.88062	7.106183	31.1075	6.77846	30.87404	6.6268	30.86115	8.4101	31.15385	8.683217	31.19575	7.21075	30.98602	7.23305
22	7.331322	31.03206	7.061489	31.03443	7.763257	30.89976	7.068583	31.08945	6.66615	30.89253	6.4724	30.88025	8.345917	31.18393	8.60195	31.18482	7.2049	30.99907	7.231
23	7.2155	31.03215	6.905971	31.0222	7.73796	30.88496	7.062867	31.06953	6.505967	30.88203	6.36752	30.9024	8.2072	31.19283	8.5374	31.19633	7.20535	30.99915	7.2293
24	7.11825	31.07858	6.835314	31.02177	7.703733	30.93012	7.061725	31.07638	6.46862	30.90686	6.30776	30.87142	8.03616	31.2086	8.481925	31.1884	7.207917	30.98863	7.22686
25	7.073129	31.08751	6.783438	31.03391	7.6196	30.95127	7.063483	31.0757	6.46146	30.88994	6.286933	30.89398	7.957633	31.18677	8.426467	31.19108	7.213643	30.98107	7.224629
26	7.085468	31.07351	6.732389	31.02662	7.596583	30.98882	7.0648	31.06281	6.4462	30.90045	6.27716	30.8951	7.895467	31.20607	8.40492	31.23214	7.220333	30.9952	
27	7.1239	31.06789	6.664386	31.0637	7.521757	31.0225	7.0666	31.03816	6.4387	30.91244	6.266417	30.87522	7.8786	31.226	8.377783	31.18092	7.22645	30.9854	
28	7.171467	31.04437	6.571013	31.05476	7.46842	31.00998	7.06375	31.0548	6.4206	30.89553	6.25095	30.87485	7.84185	31.20083	8.36024	31.20404	7.231614	30.99226	
29	7.193013	31.05136	6.520125	31.06823	7.440883	31.0269	7.060683	31.04635	6.4095	30.8838	6.239625	30.87488	7.8065	31.21238	8.31508	31.14966	7.240433	30.99705	
30	7.1271	31.04581	6.516633	31.0456	7.353433	31.05817	7.04596	31.05168	6.381883	30.8953	6.241083	30.86503	7.76735	31.19773	8.288117	31.1659	7.261014	30.89976	
31	7.0296	31.0785	6.512567	31.05821	7.303457	31.0459	7.030333	31.04915	6.38434	30.90342	6.2498	30.8641	7.749567	31.19668	8.2295	31.18925	7.26706	31.01226	
32	6.8937	31.11553	6.5051	31.04346	7.21676	31.04726	7.013567	31.0534	6.36776	30.87668	6.2512	30.85643	7.72455	31.19783	8.1763	31.16726	7.236807	31.27783	
33	6.775067	31.06562	6.499271	31.05027	7.136243	31.07026	6.994514	31.05307	6.373029	30.90873	6.247483	30.87058	7.71222	31.17456	8.106617	31.18147	7.2825	31.1063	
34	6.656975	31.07414	6.482391	31.06084	7.035786	31.10197	6.9581	31.0665	6.398525	30.90053	6.22595	30.87002	7.69452	31.19622	8.03798	31.1506			
35	6.5774	31.06542	6.4701	31.1214	6.972457	31.08057	6.900957	31.07657	6.390783	30.91463	6.221517	30.87033	7.634783	31.18317	7.991317	31.17917			
36	6.553429	31.10024			6.758242	31.32571	6.86805	31.1311	6.384867	30.90067	6.225633	30.86557	7.5903	31.17763	7.8993	31.20046			
37	6.552443	31.08421			6.7821	31.1627			6.363217	30.90947	6.225025	30.85575	7.562633	31.19233	7.72194	31.2178			
38	6.547525	31.08313							6.37335	30.91362	6.219714	30.8551	7.5192	31.18558	7.599686	31.22209			
39									6.3755	30.9168	6.2054	30.86768	7.499386	31.18606	7.50562	31.21166			
40									6.3738	30.92203	6.19715	30.86922	7.49348	31.18574	7.453917	31.23813			
41									6.369517	30.91672	6.190233	30.8623	7.480567	31.18003	7.396683	31.23347			
42									6.363433	30.91015	6.1789	30.86663	7.470267	31.18185	7.37324	31.23764			
43									6.342733	30.91998	6.17214	30.86376	7.4714	31.18108	7.34888	31.2225			
44									6.32016	30.91358	6.160983	30.86735	7.470117	31.17933	7.34545	31.2298			
45									6.28115	30.93238	6.157183	30.87255	7.466233	31.18138	7.342033	31.22707			
46									6.24944	30.92432	6.158483	30.86738	7.454783	31.18027	7.3428	31.22205			
47									6.218983	30.92635	6.1548	30.8684	7.44625	31.21143	7.34634	31.22542			
48									6.21745	30.9292	6.152883	30.87163			7.344233	31.22525			
49									6.21445	30.9284	6.149933	30.86833			7.341229	31.21843			
50									6.2133	30.9282	6.1493	30.8657			7.34112	31.22034			
51									6.21115	30.92915					7.344233	31.21392			
52									6.214825	30.9213					7.34554	31.21336			
53									6.214283	30.92578					7.344717	31.2126			
54									6.211029	30.92529					7.3478	31.20887			
55									6.20526	30.92158					7.346983	31.2171			

Table 9. Salinity, S (parts per thousand) and temperature, T (°C) measurements by station and depth (m) caught during the larval survey in Penobscot Bay from June 24 - 25, 1997 (PBVII).

SB5	TB6	SB6	TC1	SC1	TC2	SC2	TC3	SC3	TC4	SC4
29.44735	11.38013	26.15513	13.1396	28.59995	11.8914	29.5613	9.9087	30.51415	10.84443	30.29347
29.51958	11.43622	26.40113	13.18005	28.83875	11.73653	29.71803	9.7828	30.46483	10.53925	30.50365
29.56376	11.3525	27.19638	12.96833	28.9283	11.61158	30.07122	10.08623	30.52432	10.3706	30.54243
29.62654	10.63594	28.17632	12.7954	29.06926	11.31434	30.19314	10.10218	30.50973	9.957529	30.58327
29.61304	9.987667	29.01303	12.62823	29.28677	11.02472	30.45012	10.0277	30.49762	9.838775	30.62688
29.70973	9.5415	29.4663	12.5395	29.49422	10.33322	30.87105	9.9387	30.54022	9.82885	30.70428
29.85852	8.98385	29.92943	12.03347	30.03627	9.89466	30.88898	9.881633	30.50937	9.8248	30.74642
30.1209	8.575	30.31686	11.34664	30.35846	9.87986	30.94368	9.683017	30.6077	9.816267	30.72456
30.18028	8.358167	30.41628	10.72973	30.62003	9.808217	30.91432	9.6658	30.53633	9.7838	30.78068
30.259	8.016267	30.65475	10.47788	30.68375	9.71994	30.87946	9.612033	30.60977	9.73964	30.82364
30.32797	7.799417	30.76168	10.318	30.79746	9.67765	30.91117	9.40614	30.58242	9.73516	30.8667
30.54048	7.5991	30.83068	10.20058	30.79362	9.66374	30.93368	9.38876	30.5924	9.71435	30.90975
30.7608	7.309383	31.03697	10.00197	30.89587	9.63438	30.86302	9.212333	30.61632	9.6872	30.89036
30.84048	7.064071	30.93089	9.754117	30.95577	9.5004	30.95996	9.042317	30.7193	9.68498	30.94086
30.9332	6.954825	30.90985	9.523383	31.0669	9.201943	30.99726	8.985133	30.7421	9.668557	30.93
30.97632			9.379075	31.0856	9.10045	31.02248	8.975	30.76923	9.667006	30.97853
30.977			9.245186	31.1375	9.0859	31.02538	8.9707	30.77876		
30.97557			9.173767	31.12432	9.067667	31.03172	8.969083	30.802		
30.97523			9.107383	31.14065	9.04128	31.04668	8.967517	30.78043		
30.96082			9.0528	31.1389	9.02425	31.01973	8.96502	30.77438		
30.97922			9.014429	31.1398	8.959567	31.0485	8.967383	30.78325		
30.97256			9.005083	31.14583	8.78515	31.10465	8.965991	30.84299		
30.98706			8.963083	31.16885	8.69482	31.12328				
30.96928			8.90938	31.1549	8.61888	31.12556				
31.01097			8.8121	31.18058	8.593667	31.1314				
			8.7384	31.20692	8.581983	31.12295				
			8.71185	31.1829	8.57504	31.1221				
			8.657633	31.19373	8.5538	31.11726				
			8.55064	31.2286	8.53952	31.129				
			8.509583	31.2188	8.505967	31.13383				
			8.491483	31.22263	8.472533	31.14125				
			8.475333	31.21017	8.43936	31.1424				
			8.463383	31.2217	8.38715	31.15368				
			8.449067	31.2106	8.367067	31.19942				
			8.4302	31.2145						
			8.415533	31.21575						
			8.40118	31.21194						
			8.387529	31.2191						
			8.373929	31.20747						
			8.36048	31.1945						
			8.34205	31.2031						
			8.315683	31.20173						
			8.2877	31.21125						
			8.2505	31.21032						
			8.228533	31.21						
			8.209917	31.21448						
			8.196517	31.21625						
			8.190817	31.21833						
			8.186817	31.22215						
			8.179183	31.2252						
			8.171533	31.22608						
			8.16515	31.23133						
			8.156233	31.23198						
			8.144688	31.23154						
			8.129933	31.23778						